



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

### Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

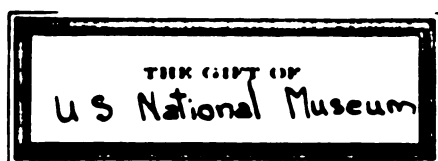
We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

### About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

**B** 1,062,456



Q  
11  
2585.6



Q  
11  
W 585-1  
SMITHSONIAN INSTITUTION  
UNITED STATES NATIONAL MUSEUM  
= Bulletin 94

HANDBOOK AND DESCRIPTIVE CATALOGUE OF  
THE METEORITE COLLECTIONS IN THE  
UNITED STATES NATIONAL MUSEUM

BY

GEORGE P. MERRILL

*Head Curator of Geology, United States National Museum*



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1910







CASA GRANDE, TUCSON, AND CANON DIABLO IRONS.  
Photographed September 5, 1911.

SMITHSONIAN INSTITUTION  
UNITED STATES NATIONAL MUSEUM  
**Bulletin 94**

---

HANDBOOK AND DESCRIPTIVE CATALOGUE OF  
THE METEORITE COLLECTIONS IN THE  
UNITED STATES NATIONAL MUSEUM



BY

GEORGE P. MERRILL

*Head Curator of Geology, United States National Museum*



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1916



**BULLETIN OF THE UNITED STATES NATIONAL MUSEUM**  
**ISSUED MAY 25, 1916.**

Gen.  
5,14  
U.S. Nat. Mus.

## ADVERTISEMENT.

The scientific publications of the United States National Museum consist of two series, the *Proceedings* and the *Bulletins*.

The *Proceedings*, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original, and usually brief, papers based on the collections of the National Museum, presenting newly acquired facts in zoology, geology, and anthropology, including descriptions of new forms of animals, and revisions of limited groups. One or two volumes are issued annually and distributed to libraries and scientific organizations. A limited number of copies of each paper, in pamphlet form, is distributed to specialists and others interested in the different subjects, as soon as printed. The date of publication is printed on each paper, and these dates are also recorded in the table of contents of the volumes.

The *Bulletins*, the first of which was issued in 1875, consist of a series of separate publications comprising chiefly monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, and catalogues of type-specimens, special collections, etc. The majority of the volumes are octavos, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable.

Since 1902 a series of octavo volumes containing papers relating to the botanical collections of the Museum, and known as the *Contributions from the National Herbarium*, has been published as bulletins.

The present work forms No. 94 of the *Bulletin* series.

RICHARD RATHBUN,  
*Assistant Secretary, Smithsonian Institution,*  
*In charge of the United States National Museum.*

WASHINGTON, D. C., March 29, 1916.

III



## PREFACE.

The handbook and catalogue presented herewith is intended primarily for the use of the general public, but the subject matter is at the same time so arranged as to meet the needs of the student and investigator as well, though naturally an exhaustive discussion of some of the more abstruse problems is omitted. The descriptive matter is most complete regarding falls of which the collections contain what is considered a fair representation. Indeed, the exhibition portion of the collection is limited to specimens of upwards of 50 grams in weight, all under this weight being relegated to the drawer or study series. The entire collection numbers at the time this catalogue goes to press 329 falls and finds, and is accompanied by an equal number of thin sections for microscopic study.

The bibliography is intentionally brief, reference being made only to such publications as have furnished the information given in the abstract. Wülfing's *Die Meteoriten in Sammlungen und ihre Literatur*, 1897, is believed to make greater elaboration unnecessary.

Since the issue of the two previous catalogues, that by Dr. F. W. Clarke in 1889, and that by Mr. Wirt Tassin in 1902, the entire collection has been re-catalogued, independent of the mineral collection of which it had previously been considered a part, and is now treated as belonging more properly to petrology.

Inasmuch as the Shepard collection is given a case by itself, it has been thought advisable to list it here independently, as was done in Doctor Clarke's catalogue of 1889. That collection comprises 234 falls and finds, of which 83 are not represented in the National Museum collection proper. The combined collections, therefore, number 412 independent falls and finds.

JANUARY 1, 1916.



## CONTENTS.

---

### PART I.

	Page.
Introduction; classification; mineral composition; chemical composition; structure; early records and opinions; phenomena and number of falls--	1

### PART II.

#### Descriptive catalogues:

A. Museum collection, alphabetical list and descriptions; list of casts-----	29
B. Shepard collection, alphabetical list and description-----	175

### APPENDIX A.

Moldavites, billitonites, and other glasses of supposed meteoric origin----	201
---	-----

### APPENDIX B.

Examples of metallic iron, in part alloyed with nickel, in terrestrial rocks-----	207
---	-----

VII



## LIST OF PLATES.

PLATE	Title.	Facing page.
1.	Casas Grandes, Tucson, and Canon Diablo irons.....	16
2.	Microstructure of (1) Juvinas and (2) Shergotty stones.....	16
3.	Microstructure of (1) El Nakhla stone and (2) Estherville mesosiderite.....	18
4.	Microstructure of (1) Estacado and (2) Selma stones.....	18
5.	Microstructure of (1) Enstatite chondrule in Elm Creek stone, (2) Enstatite chondrule in Hendersonville stone, (3) Enstatite chondrule in Coon Butte stone, (4) Enstatite chondrule in Tennesilm stone, (5) Barred olivine chondrule in Beaver Creek stone.....	18
6.	Microstructures showing (1) variations in size and form of chondrules in Cullison stone, (2) large oval chondrule in Tennesilm stone, (3) angular chondrule with border of metallic iron in Parnallee stone, and (4) clino-enstatite chondrule in Cullison stone.....	20
7.	Microstructure of (1) black crust on Allegan stone, and (2) of black vein in Bluff stone.....	20
8.	Two specimens of Admire pallasite, as found.....	30
9.	Section of (1) metallic portion, and (2) polished slice of Admire pallasite.....	30
10.	Polished slices of (1) Ahumada pallasite, and (2) of Ainsworth iron.....	30
11.	Polished slice of (1) Brenham pallasite, and (2) the Allegan meteoric stone.....	34
12.	Polished slice of (1) Canon Diablo iron, and (2) etched slice of Arispe iron.....	34
13.	Oxidized Canon Diablo iron, (1) as found, (2) sliced to show metallic nucleus.....	50
14.	Etched slice of Canon Diablo iron, showing numerous troilite nodules.....	50
15.	Casas Grandes iron, weight 3,407 pounds.....	52
16.	Etched slice of Casas Grandes iron.....	52
17.	(1) Canon Diablo iron, showing large cavity, and (2) Couch, Coahuila, or Sanchez Estate iron.....	52
18.	Two views of the Cullison stone, as found.....	60
19.	Polished slices of the Cullison stone, (1) enlarged about 5 diameters, (2) about two-thirds natural size, and (3) iron sulphide capped at right by metallic iron.....	60
20.	Etched slices of (1) Kendall County, and (2) Coopertown irons.....	60
21.	(1) Felix stone, as found, and (2) the third largest stone of the Fisher fall, weighing 1,300 grams.....	71
22.	Etched slice of Gibeon (Mukerop) iron.....	74
23.	Two views of Hendersonville stone, as found.....	78

	Facing page.
PLATE 24. Microstructure of the Hendersonville stone.....	78
25. Complete individuals of (1) Holbrook and (2) Modoc stones.....	81
26. Microstructure of the Indarch stone.....	85
27. Mount Vernon pallasite, as found.....	114
28. Polished slice of Mount Vernon pallasite.....	114
29. Front and reverse of Perryville iron, as found, about one-half natural size.....	126
30. Etched surfaces of Perryville iron, (1) enlarged about 2 diameters, and (2) magnified surface photographed under the microscope by reflected light.....	126
31. Polished surface of (1) Persimmon Creek, and (2) of Putnam County irons.....	130
32. Two views of the Rich Mountain stone.....	130
33. (1) Etched slice of Sacramento iron, (2) Dendritic schreibersite in Arispe iron, (3) Etched slice of Santa Rosa iron, showing numerous troilite nodules.....	135
34. Microstructure of the Selma stone, (1) showing microstructure and fragmental nature of olivine and enstatites, (2) chondrules of porphyritic olivine, and (3) chondrule of cryptocrystalline enstatite.....	148
35. View of (1) Thomson stone, about three-fourths natural size, and (2) etched slice of Toluca iron.....	157
36. Etched slice of (1) Willamette iron, and (2) of Tombigbee River iron, showing large schreibersite inclosures.....	170
37. Prof. Charles Upham Shepard (portrait).....	174
38. Shepard collection of meteorites in the U. S. National Museum.....	175
39. (1) The Dalton iron and (2) New Concord stone, from the Shepard collection.....	181
40. Specimens of the Estherville mesosiderites, from the Shepard collection.....	183
41. Moldavites and similar sporadic glasses, (1-3) billitonites from the island of Billiton, (4-6) moldavites from Moldavia and Bohemia, and (7-9) australites and an obsidian button from Australia.....	201

# HANDBOOK AND DESCRIPTIVE CATALOGUE OF THE METEORITE COLLECTIONS IN THE UNITED STATES NATIONAL MUSEUM.

---

By **GEORGE P. MERRILL,**

*Head Curator of Geology, United States National Museum.*

---

## PART I.

### INTRODUCTION.

The name meteorite is given to the masses of metal and mineral matter which come to the earth from space in the form of falling bodies and which are commonly considered identical in nature with the meteors, or so-called shooting stars, which on clear nights may often be seen darting rocket-like across the sky. The origin of these bodies was for a long time in question, and even now we are quite in the dark concerning their ultimate source, though there is apparently little doubt that they are from regions outside of our solar system and come to us in the form of gradually disintegrating comets.

The elemental matter of meteorites is the same as that of the earth, though differing apparently in proportional amounts and certainly often in form of combination. The most abundant of the meteoric elements are, named in alphabetical order: Aluminum, Calcium, Carbon, Iron, Magnesium, Nickel, Oxygen, Phosphorus, Silicon, and Sulphur. More rarely and in smaller quantities are found Chlorine, Chromium, Cobalt, Copper, Hydrogen, Iridium, Lithium, Manganese, Nitrogen, Palladium, Platinum, Potassium, Ruthenium, Sodium, Titanium, and Vanadium, probably also Argon and Helium. The presence of Antimony, Arsenic, Gold, Lead, Strontium, Tin, and Zinc has from time to time been reported, but recent investigation has thrown doubt upon the correctness of the determinations.<sup>1</sup>

Meteorites vary in composition from those which are composed almost wholly of the silicate minerals, olivine and pyroxene, with perhaps a little feldspar, to those which are almost wholly of nickel-iron. Frequent gradations are met with, but nevertheless it is pos-

---

<sup>1</sup> Merrill, On the minor constituents of meteorites, *Amer. Journ. Sci.*, vol. 35, 1913, p. 509.  
5692"—Bull. 94—16—1

sible, as a rule, to separate them into three somewhat ill-defined groups, as follows:

Aerolites or Stony Meteorites.	} Consisting essentially of silicate minerals with minor amounts of the metallic alloys and sulphides.
Siderolites or Stony-iron Meteorites.	
	} Consisting of an extremely variable network or sponge of metal, the interstices of which are occupied by the silicate mineral.
Siderites or Iron Meteorites.	} Consisting essentially of an alloy of nickel-iron with iron phosphides and sulphides.

Examples of these are shown in the introductory series in the case.

Many attempts have been made at a more detailed classification than that given above, the one most generally accepted being that proposed by Dr. A. Brezina, formerly in charge of the meteorite collections of the Austrian Museum, in Vienna. It is altogether too technical for the general reader, and indeed the distinctions are often founded on matters of such minor importance that fragments from different portions of the same mass have been classed under quite different heads. It is, however, the form followed here, though without too great emphasis on what are believed to be matters of minor import. It may be well to state in advance that the term *chondrule* (Latin *Chondrum* and *Chondri*) refers to the peculiar spherical and oval shapes often assumed by the silicate constituents, the formation of which affords one of the most interesting puzzles in connection with the origin of meteorites, and further, that all known meteorites are of an igneous nature.

#### CLASSIFICATION.

##### I. METEORIC STONES: AEROLITES.

A. Meteorites rich in calcium and aluminum-bearing minerals, poor in nickel-iron and without chondrules.

1. *Angrite* (A): Consisting essentially of a calcium rich augite with a little olivine and iron sulphide; structure crystalline granular.

2. *Eukrite* (Eu): Consisting essentially of augite and anorthite with a little iron sulphide; structure basaltic.

3. *Shergottite* (Sh): Consisting essentially of augite and maskelynite with a little magnesia; structure crystalline granular.

4. *Howardite* (Ho and Hob): Consisting essentially of augite, anorthite, bronzite, and olivine; structure in part tuff-like and in part crystalline.

B. Meteorites rich in magnesian minerals, poor in nickel-iron, and for the most part without chondrules.

1. *Bustite* (Bu): Consisting essentially of diopside and bronzite with sometimes plagioclase, nickel-iron, osbornite, and oldhamite; structure crystalline.

2. Chassignite (Cha): Consisting essentially of olivine and a little chromite; structure crystalline granular.

3. Chladnite (Chl): Consisting essentially of a rhombic pyroxene; structure crystalline granular.

4. Amphoterite (Am): Consisting essentially of olivine and bronzite with a little iron sulphide and nickel-iron; structure sometimes granular, sometimes chondritic.

*C.* Meteorites rich in magnesium minerals and consisting essentially of olivine, bronzite, nickel-iron, and iron sulphide, with a fragmental or tuff-like base and chondritic structure.

1. Howarditic chondrite (Cho): A group intermediate between the chondrites and achondrites.

2. White chondrites: Consisting of a yellowish-white tuffaceous base with chondrules mostly of the same color. This group is divided into three subgroups: (a) White chondrites (Cw); (b) veined white chondrites (Cwa), and (c) breccia-like white chondrites (Cwb).

3. Intermediate chondrites: A group including forms intermediate between the white and the gray chondrites. This group is divided also into three subgroups: (a) Intermediate chondrites (Ci), (b) veined intermediate chondrites (Cia), and (c) breccia-like intermediate chondrites (Cib).

4. Gray chondrites: Consisting of a yellowish to a bluish-gray tuff-like base, with variously colored chondrules which are firmly embedded in the groundmass. The group is divided into: (a) Gray chondrites (Cg), (b) veined gray chondrites (Cga), and (c) breccia-like gray chondrites (Cgb).

5. Black chondrites: Consisting of a dark gray to black, firm chondritic mass, the color of which is due in part to carbon and in part to iron sulphide; chondrules mostly of a light color.

6. Spherical (Kügelchen) chondrites: Consisting of numerous hard and well-formed chondrules in varying proportions, in a tuff-like or crystalline ground, sometimes so loosely imbedded as to break away from the ground and sometimes breaking with it. This group is divided into five subgroups, as follows: (a) Ornansite and Ngawite (Cco and Ccn); (b) spherical or Kügelchen chondrites (Cc); (c) veined Kügelchen chondrites (Cca); (d) breccia-like Kügelchen chondrites (Ccb); (e) crystalline Kügelchen chondrites (Cck).

7. Crystalline chondrites: Consisting of a crystalline groundmass with firmly imbedded chondrules. The group is divided into three subgroups: (a) Crystalline chondrites (Ck); (b) veined crystalline chondrites (Cka); (c) breccia-like crystalline chondrites (Ckb).

8. Carbonaceous chondrites (K and Kc): This includes a group of chondritic stones impregnated with carbon and containing little or no iron.

9. Orvinite (Co): A small group consisting of chondrules in a blackish ground, showing a fluidal structure. It has at present but one representative.

10. Tadjerite (Ot): Consisting of a dark, for the most part half glassy ground containing chondrules.

11. Ureilite (Cu): Consisting essentially of olivine, with sometimes chondritic and sometimes granular structure, of a dark, nearly black color, and often showing transition stages into the next class.

## II. STONY-IRON METEORITES: SIDEROLITES.

Meteorites consisting of silicate minerals in a more or less disconnected mesh or sponge of nickel-iron.

1. Lodhranite (Lo): Consisting of a crystalline granular mixture of olivine and bronzite in a fine, more or less disconnected network or sponge of metal.

2. Mesosiderite (Grahamite) (M): Consisting essentially of olivine, bronzite, plagioclase, and augite, sometimes chondritic, sometimes crystalline granular, in a more or less interrupted network or sponge of metal.

3. Siderophyre (S): Consisting essentially of bronzite and nickel-iron with accessory asmanite in a network of nickel-iron of octahedral crystallization and showing Widmanstätten figures.

4. Pallasite (P): Consisting of olivine in a continuous network or sponge of metal.

5. Meteoric iron breccia (Obc): Meteorites consisting of crystalline chondrules in a breccia-like mass of octahedral iron.

6. Meteoric iron of Netschaëvo (Omn): Meteorites consisting of crystalline chondrules in a mass of octahedral nickel-iron.

## III. NICKEL-IRON METEORITES: SIDERITES.

Meteorites consisting essentially of nickel-iron with iron sulphide and phosphide and usually graphite or other form of carbon.

1. Octahedral irons: Consisting essentially of nickel-iron alloys arranged in the form of plates parallel with the faces of an octahedron, and often interlaminated with thin plates of schreibersite. On etching with acid they show Widmanstätten figures. According to the thickness of the plates they are divided as follows: (a) Octahedral irons with lamellæ 0.1 mm. in thickness (Of); (b) octahedral irons with lamellæ 0.15 to 0.4 mm. in thickness (Of); (c) octahedral irons with lamellæ 0.5 to 1 mm. in thickness (Om); (d) octahedral irons with lamellæ 1.5 to 2 mm. in thickness (Og); (e) octahedral irons with lamellæ over 2½ mm. in thickness (Ogg); (f) breccia-like octahedral irons (Obz).

2. Hexahedral irons: Homogeneous masses of nickel-iron with evident cleavage parallel to the faces of a hexahedron and showing lamellæ due to the twinning of a cube on an octahedral face. On etching they show Neumann lines. These are divided into: (a) hexahedral irons (H); (b) brecciated hexahedral irons (Hb); (c) the Cape Iron group (Hca); (d) the Chesterville group (Hch).

3. Massive irons: Amorphous irons showing neither Neumann nor Widmanstätten lines or other structural features such as permit satisfactory classification. Doctor Brezina has divided them into five groups: (a) the Babb's Mill group (Db); (b) the Nedagolla group (Dn); (c) the Primitiva group (Dp); (d) the Senegal group (Ds); (e) the Tucson group (Dt).

#### MINERAL COMPOSITION.

Though the elemental matter of meteorites may be the same as in terrestrial rocks, the form of combination is at times radically different and of a nature to indicate that they formed under conditions quite unlike those existing on the earth to-day, and particularly so with reference to the presence of free oxygen and moisture.

The following list comprises meteoric minerals which are also constituents of terrestrial rocks: *Olivine*, the orthorhombic pyroxene *enstatite* (or *bronzite*), the monoclinic pyroxenes *diopside* and *augite*, the plagioclase feldspars *anorthite*, *labradorite*, or *oligoclase*, the phosphate *apatite*, the oxides *magnetite* and *chromite*, the sulphides *pyrite* and *pyrrhotite*, rarely the carbonate *breunnerite* and various forms of carbon including *graphite* and *diamond*. Those minerals found rarely if ever in terrestrial rocks are the various alloys of nickel and iron, to which the names *kamacite*, *taenite*, and *plessite* have been given, the nickel and iron phosphide *schreibersite*, the iron monosulphide *troilite*, the iron and chromium sulphide *daubreelite*, the iron protochloride *lawrencite*, the calcium and titanium (or zirconium) oxysulphide *osbornite*, the iron and nickel carbide *cohenite*, the carbon silicide *moissanite*, an isotropic mineral believed to be a re-fused plagioclase and called *maskelynite*, and *asmanite*, a form of silica. These are described in some detail, in alphabetical order, below:

*Apatite*.—The phosphoric acid reported in the numerous analyses of meteoric stones has usually been considered a constituent of the mineral apatite. As a matter of fact, crystals of this mineral in a meteorite have been actually observed only by Berwerth, in the stony portion of the Kodaikanal, India, siderolite. Recent investigations have shown that the prevalent phosphatic mineral is not apatite, but a mineral of nearly the same composition, differing in its crystallographic and optical properties, and perhaps identical with francolite. Its exact nature remains yet to be ascertained.

*Asmanite*.—This name was proposed by Maskelyne<sup>1</sup> for a mineral consisting essentially of silica, occurring in the meteorite of Breitenbach, of which it composed nearly one-third of the siliceous portion. The mineral, when pure, is colorless, with a specific gravity of 2.245, a hardness of 5.5, and is rhombic in crystallization. It is commonly believed to be identical with the tridymite of terrestrial rocks.

*Breunnerite*.—This is the name given by Haidinger to a ferriferous variety of magnesium carbonate found in terrestrial rocks and in a single instance in a meteoric stone, that of Orgueil, France. It is the only instance known of a carbonate compound occurring as an original constituent of meteorites.

*Carbon*.—Carbon as carbon monoxide (CO) or dioxide (CO<sub>2</sub>), as a hydrocarbon or in the amorphous, or crystalline form of graphite, has been recognized as a constituent of certain meteorites, particularly meteoric irons, for many years. Berzelius recognized a carbon compound in the stone of Alais as early as 1838. Wöhler and Cloez in 1839 found compounds resembling residue from terrestrial organic substances in the meteoric stone of Cold Bokkeveld, while the French chemist Berthelot extracted hydrocarbons conformable with the petroleum series from the carbonaceous meteoric stone that fell in Orgueil, France, in 1864. The American chemist J. Lawrence Smith and others have since repeatedly reported the presence of carbon in both the amorphous and crystallized forms of graphite in numerous analyses of stone and iron meteorites.

Haidinger, in 1846, described a cubic form of graphite in the meteoric iron of Arva (Magura), Hungary, as pseudomorphic after pyrite, but which Rose suggested was pseudomorphic after diamond. In 1886 H. Carvill Lewis, after studying the matrix of the South African diamond, predicted the discovery of diamonds in meteorites. In 1888 Jerofeieff and Latschinoff found carbon with the hardness and form of the diamond in the Novo-Urei, Russia, meteoric stone. In 1889 was found the first colorless material, thought from its hardness and its burning into CO<sub>2</sub> to be diamond, in the Arva iron. In 1891 George A. Koenig of Philadelphia found a black vitreous substance, of a hardness beyond sapphire and believed to be diamond, in the meteoric iron of Canon Diablo. Material from this source was subsequently examined by O. W. Huntington and found to contain unmistakable, minute, colorless, octahedral crystals of diamond. Two examples of these are shown in Exhibit No. 473. The French chemist Moissan in this same iron found in addition carbon in the amorphous form, as graphite, and as black diamond or carbonado. *Moissanite*, a silicide of carbon, perhaps identical with artificial carborundum, was found by this chemist in the meteoric iron of Canon Diablo.

<sup>1</sup> Philos. Trans. Royal Soc. London, 1871, p. 361.

*Chromite and magnetite*.—The oxides of chromium and iron, or of iron alone, are common constituents of terrestrial rocks as well as of meteorites, and need no further mention here other than that they occur as small, usually microscopic disseminated crystals and crystalline grains.

*Daubreelite*.—In 1876 J. Lawrence Smith gave this name to a black, lustrous, highly crystalline material found by him associated with the troilite in the meteoric irons of Coahuila, Mexico. Incomplete analyses made at the time showed 36.48 per cent of sulphur, some 10 per cent of iron, and a little carbonaceous matter, the undetermined portion being chromium. The true composition he announced as being, probably, sulphur 37.62 per cent; chromium 62.38 per cent.<sup>1</sup> Later he was able to isolate the material in larger quantity and greater degree of purity from the Coahuila iron, and in 1878<sup>2</sup> he published new analyses and descriptions showing the mineral to have the probable composition: Sulphur, 44.29 per cent; chromium, 36.33 per cent; iron, 19.38 per cent; or the formula  $\text{FeS Cr}_2 \text{S}_2$ . Actual analyses, however, showed: Sulphur, 42.69 per cent; chromium, 35.91 per cent; iron, 20.10 per cent; total, 98.70 per cent.

*Feldspars and maskelynite*.—From what is known regarding terrestrial basic igneous rocks, the feldspars of meteorites would naturally be assumed to belong to the more basic varieties, as labradorite and anorthite. Not many actual and complete analyses are available owing to the difficulty of securing a sufficient quantity of material in a fair degree of purity. Those quoted below show that in at least two instances the feldspar is oligoclase, a form characteristic of rocks of intermediate acidity, as the diorites. The name *maskelynite*, it should be stated, was given by Tschermak<sup>3</sup> to an isotropic, colorless mineral, abundant in the Shergotty meteorite, and commonly considered a re-fused feldspar. The mineralogist Groth, on the other hand, was inclined to believe it to be a species allied to leucite. The feldspars are common constituents of meteorites of the basaltic types, such as that of Juvinas in France, where they occur in elongated polysynthetically twinned forms as in terrestrial rocks. In the chondritic types they occur as scattered granules occupying the interspaces of the olivines and enstatites, and often quite lacking in crystal outlines or twinning bands, in which case their satisfactory determination is a matter of great difficulty. In many meteorites of the chondritic type, and in most pallasites, feldspars are wholly lacking.

<sup>1</sup> Amer. Journ. Sci., vol. 12, 1876, p. 109.

<sup>2</sup> Idem, vol. 16, 1878, p. 270.

<sup>3</sup> Sitz. Akad. Wiss. Wien, vol. 65, 1872, p. 127.

*Analyses of meteoric feldspars.*

Constituents.	Sources.		
	Hvittia. <sup>1</sup>	Hessle. <sup>2</sup>	Shergotty. <sup>3</sup>
Silica.....	63.5	64.97	56.3
Alumina.....	22.2	22.06	25.7
Lime.....	4.0	3.01	11.6
Soda.....	9.2	9.96	5.1
Potash.....	1.1	.....	1.3
	100.0	100.0	100.0

<sup>1</sup> Borgström, Bull. Comm. geol. Finlande, No. 14, 1903.<sup>2</sup> Lindström, Öfv. Kongl. Vet.-Akad. Förhandl., 1869, p. 723.<sup>3</sup> Tschermak, Sitzb. Akad. Wiss. Wien, vol. 65, 1872, p. 130.

From these analyses it would appear that 1 and 2 are to be classed as oligoclase and 3 as labradorite.

*Gaseous constituents.*—The fact that hydrogen was given off when the Lenarto (Italy) meteoric iron was heated in a vacuum was first noted by Thomas Graham in 1867. J. W. Mallet, in 1872, found the meteoric iron of Augusta County, Va., under similar circumstances yielded not merely hydrogen but also nitrogen and carbon monoxide (CO) and carbonic acid (CO<sub>2</sub>). A. A. Wright, in 1875 and 1876, showed (1) that the stony meteorites differ from the iron in having oxides of carbon, chiefly as CO<sub>2</sub>, as their characteristic gases, instead of hydrogen; (2) the proportion of CO<sub>2</sub> given off at low is greater than at high temperatures; (3) the amount of gases contained in a large meteorite, or cluster serving as a cometary nucleus, is sufficient to form the train; (4) the spectrum of the gases is closely identical with that of several comets.

Doubts which may have been thrown on these results as first announced were eliminated by the later investigations. In the stony (chondritic) meteorites the percentage of CO is conspicuously small compared with that of CO<sub>2</sub>, while in the irons the conditions are reversed. Recent work by R. T. Chamberlin furnished data for the following summary of averages:

Type.	No. of analyses.	CO <sub>2</sub> .	CO.	CH <sub>4</sub> .	H <sub>2</sub> .	N <sub>2</sub> .	Total.
Stony meteorite.....	12	3.77	0.24	0.20	0.50	0.09	4.80
Iron meteorite.....	9	.21	.67	.02	1.67	.24	2.81

Subsequently Prof. William Ramsay, of London, detected the probable presence of argon and helium.

*Lawrencite.*—Protochloride of iron. The exudation of drops of ferrous chloride from freshly cut or broken surfaces of meteoric iron

was early noted, but it was not until 1855 that J. Lawrence Smith found the material in the condition of a soft solid of a green-brown color in the meteoric iron of Tazewell County, Tenn.<sup>1</sup> In 1877<sup>2</sup> he also noted the occurrence of the substance in the iron of Rockingham County, N. C. In this same year Daubree noted its occurrence in the terrestrial iron of Ovifak, Greenland,<sup>3</sup> and proposed for it the name *lawrencite* in honor of its first discoverer. The material liquefies on exposure to the atmosphere, the iron passing over quickly to the condition of sesquioxide. It is this feature that brings about the rapid disintegration of so many irons and causes the stone meteorites to become rust-brown or freckled with rust-colored spots.

*Metallic constituents; nickel-iron alloys.*—These are essentially the same in all meteorites. They occur in varying proportions from a fraction of 1 per cent, as in the Bishopville stone, to upward of 90 per cent, as in the so-called iron varieties. In the stones the form is that of disconnected drops or stringers; in the pallasites that of a more or less disconnected mesh or sponge enfolding silicate minerals; and in the metallic forms constituting nearly the entire mass. Etching by means of a weak acid, the polished surface of a meteoric iron will in the majority of cases give rise to an interesting series of markings known under the name of Widmanstätten figures, after a German chemist who first brought them to public notice. They are due to the unequal solubility of the three alloys of iron and nickel which make up the mass of the material. Two of these alloys occur in the form of thin plates and are known by the terms *kamacite* and *taenite*. A third alloy, known as *plessite*, fills the space formed by the intersection of these plates (see etched slices of the Casas Grandes and Toluca irons, pls. 16 and 35). The composition of these alloys has not been absolutely determined, owing to the difficulty of separating them one from another, and it is considered probable that the so-called plessite is but a mixture or intergrowth of the other two. Davison gives the composition of the two first named as determined on separations made from the Welland, Canada, iron, as follows:

Constituents.	Kamacite.	Taenite.
	<i>Per cent.</i>	<i>Per cent.</i>
Iron.....	93.09	74.78
Nickel.....	6.09	24.32
Cobalt.....	.25	.33
Carbon.....	.02	.50
	100.05	99.93

<sup>1</sup> Amer. Journ. Sci., vol. 19, 1855, p. 154.

<sup>2</sup> Idem, vol. 13, 1877, p. 214.

<sup>3</sup> Compt. Rend., vol. 84, 1877, p. 66.

In the Casas Grandes, Toluca, and many other irons, these plates are arranged parallel with the faces of an octahedron, as shown in the examples in the introductory series. Such are known as octahedral irons. Other irons yielding no Widmanstätten figures give, on etching, lines which the mineralogist Neumann showed might result from a twinning of a cube about an octahedral face. These are known as hexahedral irons, an example of which is shown in the slice from Scottsville, Kentucky (No. 77), or in the large "Couch" iron. Still other irons have no regular structure, sometimes, indeed, being almost uniformly homogeneous. Such are classed as ataxites, an example of which is shown in the specimen from Deep Springs, North Carolina (No. 470). *Cohenite* is the name proposed by Weinschenk for an iron carbide of a tin-white color, found first in the meteorite of Magura and subsequently in other irons.

*Oldhamite*.—This name was given by Story-Maskelyne, in 1862, to a calcium sulphide found by him in the meteorite of Busti, and described in detail in the Philosophical Transactions of the Royal Society of London for 1870. The mineral is of a pale, chestnut-brown color when pure, though often covered on the outer surface by a gypseous oxidation product. It occurs in the form of rounded granules, with cleavages essentially rectangular, imbedded in the pyroxenic constituents. Between crossed nicols it is isotropic, and is considered to belong undoubtedly to the cubic, or isometric system. Its specific gravity was found to be 2.58. Boiled in water it was decomposed, yielding a bright yellow solution of calcium polysulphide and an insoluble residue.

*Olivine*.—A magnesium and iron silicate of the formula  $(MgFe)SiO_3$ ; relative proportions of magnesia and iron are, however, somewhat variable, as shown in the following analyses:

Locality.	$SiO_2$ .	$MgO$ .	$FeO$ .
1. Krasnojarsk, Siberia.....	40.24	47.41	11.80
2. Kiowa County, Kansas.....	40.70	48.02	10.79
3. Brahin, Russia.....	39.61	48.29	11.88
4. Atacama, Chile.....	38.92	48.16	17.21

The mineral rarely occurs in good crystal form except in the porphyritic chondrules. It is of all meteoric minerals perhaps the most abundant and widespread, sometimes, as in that of Warrenton, Missouri, composing a very large proportion (75 per cent) of the mass of the stone. It is rarely, if ever, wholly absent, even the iron meteorites showing in most cases included granules. It is a common and widespread constituent of terrestrial igneous rocks.

**Osbornite.**—This name is also one of Maskelyne's proposal. The mineral occurs in golden yellow microscopic octahedra, associated with the oldhamite in the Busti meteorite. Crystals are brittle and insoluble in acids, even resisting the fluxes potassium and sodium carbonates. Composition uncertain, but regarded as a titanium or zirconium oxychloride.

**Pyroxenes.**—Pyroxene is common in meteorites in both orthorhombic and monoclinic forms.

1. Orthorhombic pyroxenes: enstatite and bronzite. These minerals, next to the olivines, are the most common of the meteoric silicate minerals. The composition is somewhat variable, owing to the varying proportions of iron and magnesia, as in the olivines. A typical enstatite corresponds to the formula  $MgSiO_3$ , but through the assumption of iron this passes over into the bronzite variety ( $MgFe$ )  $SiO_3$ . So far as known, the highly ferriferous and pleochroic variety, hypersthene, never occurs in meteorites, though in at least one instance—that of Shalka, India—the percentage of iron is fully as high as in strongly pleochroic hypersthene. The name clino-enstatite has been given to a monoclinic variety with a smaller extinction angle on clinopinacoidal sections than other monoclinic pyroxenes, and which is characterized further by a marked tendency toward polysynthetic twinning. The varying composition of enstatite and bronzite from some of the best known meteorites is given below:

Locality.	SiO <sub>2</sub> .	MgO.	FeO.	Na <sub>2</sub> O.	K <sub>2</sub> O.	CaO.	Al <sub>2</sub> O <sub>3</sub> .
Bishopville <sup>1</sup> .....	59.97	39.34	0.40	.....	.....	.....	.....
Busti <sup>2</sup> .....	58.44	38.94	1.18	0.36	0.33	1.68	.....
Lodhran <sup>3</sup> .....	55.35	32.85	12.13	.....	.....	.58	0.60
Breitenbach <sup>4</sup> .....	56.05	30.85	13.44	.....	.....	.....	.....
Hainholz <sup>5</sup> .....	53.05	25.40	15.63	.....	.....	2.73	3.19
Hvittis <sup>6</sup> .....	59.05	37.10	.90	.68	.47	.98	1.09
Goalpara <sup>7</sup> .....	59.92	38.00	.....	.....	.....	2.11	.....
Molina <sup>8</sup> .....	57.8	39.22	.91	.....	.....	.....	2.07
Shalka <sup>9</sup> .....	55.55	27.73	16.53	.92	.....	.09	.....
Rittersgrün <sup>10</sup> .....	57.49	25.78	10.59	1.45	.....	2.12	2.08

<sup>1</sup> Smith, J. L., Amer. Journ. Sci., vol. 38, 1864, p. 225.

<sup>2</sup> Maskelyne, Philos. Trans. Roy. Soc. London, vol. 160, 1870, p. 206.

<sup>3</sup> Tschermak, Sitz. Akad. Wiss. Wien, vol. 61, 1870, p. 467.

<sup>4</sup> Maskelyne, Philos. Trans. Roy. Soc. London, vol. 161, 1871, p. 359.

<sup>5</sup> Rammelsberg, Monatsber. Akad. Berlin, 1870, p. 314.

<sup>6</sup> Borgström, Bull. Comm. geol. Finlande, No. 14, 1903.

<sup>7</sup> Teclu, Rammelsberg's Mineralchemie, 1875, p. 382.

<sup>8</sup> Meunier, Ann. Chem. Phys., vol. 17, 1868, p. 12.

<sup>9</sup> Rammelsberg, Monatsber. Akad. Berlin, 1870, p. 319.

<sup>10</sup> Winkler, Cohen's Meteoritenkunde, Heft 1, 1894, p. 281.

As with olivine, the mineral rarely occurs in good crystal form, excepting in the porphyritic chondrites. A more common form, as noted later, is in that of radiating and cryptocrystalline kugels.

2. Monoclinic pyroxenes: diopside and diallage. These forms of pyroxene are, on the whole, less common in meteorites than are the orthorhombic forms, though it is possible that they are in reality more abundant than is generally supposed, their close resemblance in all but optical properties (which, owing to the small size and poorly developed crystallization, can not always be determined) rendering a sure discrimination somewhat difficult. The composition is, presumably, fully as variable as that of the enstatites, but few actual analyses of pure materials have been made, owing to the difficulty in separating them from the associated minerals. Of the following analyses No. I is by Maskelyne<sup>1</sup> and II by Tschermak.<sup>2</sup>

Constituents.	Source.	
	I. Bustl.	II. Schergotty.
Silica (SiO <sub>2</sub> ).....	55.49	52.34
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....		.25
Ferrio oxide (Fe <sub>2</sub> O <sub>3</sub> )..	.55	.....
Ferrous oxide (FeO).....		23.19
Magnesia (MgO).....	23.33	14.29
Lime (CaO).....	19.98	10.49
Soda (Na <sub>2</sub> O).....	.55	.....
Sp. gr.....	99.90	100.56
		3.466

As with other silicate constituents, the monoclinic pyroxenes are but poorly developed crystallographically, are nearly colorless, non-pleochroic, and with extinction angles rarely going beyond 25°. They are often intergrown with enstatites, and still more commonly occur in twinned forms grouped in chondrules.

*Schreibersite*.—This mineral, first described and named by Haidinger in 1847 as a constituent of the Magura iron, and since found as one of the commonest of the accessory meteoric constituents, is a phosphide of nickel, iron, and cobalt, corresponding to the formula (FeNiCo)<sub>3</sub>P. It occurs commonly in thin angular plates of a tin-white color, sometimes lying parallel with the taenite-kamacite plates, sometimes in angular, jagged masses as in the Tombigbee iron (see specimen No. 252, also pl. 36), and in dendritic forms as in the iron of Arispe (see specimen No. 299 and pl. 33, fig. 2). In the pallasites it may occur in thin plates lying between the olivines and metallic mesh. It is magnetic, and difficultly soluble, the last feature rendering its separation from the other constituents a matter

<sup>1</sup> Philos. Trans. Roy. Soc. London, vol. 160, 1870, p. 202.

<sup>2</sup> Sitzb. Akad. Wiss. Wien, vol. 65, 1872, p. 126.

of comparative ease. The material No. 475, separated from one of the Canon Diablo irons, is shown by Mr. Tassin's analysis to have the following composition:

	Per cent.
Iron -----	63.04
Nickel -----	23.07
Phosphorus -----	13.80
Cobalt -----	.03
	<hr/> 99.94

The name *rhabdite* has been given to a very brittle phosphide of apparently the same composition as schreibersite and commonly regarded as a morphological variety of that mineral.

*Troilite*.—This name was given by Haidinger<sup>1</sup> to a monosulphide of iron first found in nodular masses in the meteorite of Albareto, and since shown to be an almost universal constituent of meteorites, (See Toluca iron, No. 347 and pl. 14.) The theoretical composition, as demanded by the formula FeS, is iron (Fe) 63.64; sulphur (S) 36.36. Actual analyses nearly always show traces of nickel and sometimes copper. The mineral was named in honor of Domenico Troili, one of the early enthusiastic defenders of the possibility of meteorite falls. Meunier and some others are inclined to regard the mineral as identical with pyrrhotite. Rose suggested the possibility that the sulphide in stony meteorites might be in the form of pyrrhotite and in the metallic as troilite. The present writer, as well as Ramsay and Borgström, have, however, shown that the sulphide in the stony meteorites may be the monosulphide troilite.<sup>2</sup>

#### CHEMICAL COMPOSITION.

A meteorite is a body of more than immediate mineralogical or petrographical interest. It furnishes tangible testimony of the nature of materials existing outside of our solar system, and affords, aside from the spectroscope, the only clue to the matter of which celestial bodies are composed. The German, Chladni, as long ago as 1794, advocated their cosmic origin, and designated them "Welt-späne" (world chips), or the remains of worlds gone to pieces, and from which other worlds might be built up. This idea with various modifications has been many times reasserted, and whatever theory one may accept as to world formation, the ultimate source of the materials remains the same. It is, therefore, of interest to compare the chemical composition of such materials as are now coming from space, or have come within historic times, with that forming the rocks of the earth's crust. In column I below is given the average

<sup>1</sup> Sitz. Akad. Wiss. Wien, vol. 47, 1863, p. 283.

<sup>2</sup> Merrill, A recent meteorite fall near Holbrook, Ariz., Smithsonian Misc. Coll., publ. 2140, vol. 60, No. 2, 1912, p. 4.

composition of stony meteorites as calculated from a large number of analyses,<sup>1</sup> and in column II that of the average composition of the igneous rocks of the earth's crust.<sup>2</sup>

It may be added incidentally that these meteoric stones, as will be noted from the analyses, belong to a very basic class of rocks—i. e., rocks low in silicic acid and correspondingly high in the basic constituents, iron and magnesia. From a terrestrial standpoint they would be classified mainly as peridotites, and a few as pyroxenites and basalts.

Constituents.	I.	II.
Silica ( $\text{SiO}_2$ ).....	38.68	50.93
Titanic oxide ( $\text{TiO}_2$ ).....	.18	.74
Tin oxide ( $\text{SnO}_2$ ).....	None.	.....
Zirconium oxide ( $\text{ZrO}_2$ ).....	None.	.03
Alumina ( $\text{Al}_2\text{O}_3$ ).....	2.88	14.97
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ).....	.....	2.58
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....	.47	.06
Vanadium oxide ( $\text{V}_2\text{O}_5$ ).....	Trace.	.02
Iron (Fe).....	11.98	.....
Nickel (Ni).....	1.15	.....
Cobalt (Co).....	.07	.....
Ferrous oxide ( $\text{FeO}$ ).....	14.68	3.42
Nickel oxide ( $\text{NiO}$ ).....	.48	.03
Cobalt oxide ( $\text{CoO}$ ).....	.06	.....
Lime ( $\text{CaO}$ ).....	2.42	4.78
Barium oxide ( $\text{BaO}$ ).....	None.	.11
Magnesia ( $\text{MgO}$ ).....	22.67	3.85
Manganous oxide ( $\text{MnO}$ ).....	.29	.10
Strontium oxide ( $\text{SrO}$ ).....	None.	.04
Soda ( $\text{Na}_2\text{O}$ ).....	.87	3.40
Potash ( $\text{K}_2\text{O}$ ).....	.21	2.99
Lithia ( $\text{Li}_2\text{O}$ ).....	Trace.	.01
Ignition ( $\text{H}_2\text{O}$ ).....	.75	1.94
Phosphoric acid ( $\text{P}_2\text{O}_5$ ).....	.26	.26
Sulphur (S).....	1.80	.11
Copper (Cu).....	.014	.....
Carbon (C).....	.15	.....
Chlorine (Cl).....	.08	.06
Fluorine (F).....	(?)	.10
Carbonic acid ( $\text{CO}_2$ ).....	(?)	.48
	100.044	100.00

The most striking of the differences brought out by the analyses are (1) the excess of silica ( $\text{SiO}_2$ ) and alumina ( $\text{Al}_2\text{O}_3$ ) in the terrestrial rocks, (2) the presence of a considerable amount of free iron and proportionately large quantities of ferrous oxide ( $\text{FeO}$ )

<sup>1</sup> Merrill, On the composition of stony meteorites, etc., Amer. Journ. Sci., vol. 27, June, 1909, p. 469.

<sup>2</sup> Clarke, Data of Geochemistry, Bulletin 491, U. S. Geol. Surv., 1911, p. 27.

and magnesia ( $\text{MgO}$ ) in the meteorites. The presence of many of the rarer elements tabulated as constituents of the terrestrial igneous rocks has not as yet been fully determined in those of meteoric origin. As has been noted, however, many of them have been found in amounts too small to estimate.

As already stated, the iron or metallic meteorites consist essentially of alloys of iron, nickel, and cobalt, with which are commonly associated the phosphide schreibersite and the sulphide troilite. In minute quantities there may be other constituents, as copper, chromium, and various silicate minerals. It is in these metallic forms also that have been found the rarer elements—platinum, palladium, iridium, ruthenium, and vanadium, and possibly gold. Farrington's tabulation of analyses seems to show that the nickel content varies with the texture, the higher percentages of this constituent being found in those of finest crystallization. The variation is, however, by no means constant. In the table on the following page is given a selected series of what are considered authentic analyses of the principal types of iron, and also, for purposes of comparison, two examples each of metal separated from the silicate portions of pallasites and stony meteorites.

## METEORIC IRONS.

Name	Chem.	P.	Ni	Co	Co	P.	S.	Mn	Si	Cr	Cl	C.	Misc.
Bliss River	Hexahedrite	92.89	5.46	0.46	0.04	0.26	0.08			0.08			Insol. res. 0.02.
Champlain	Quartz octahedrite	92.426	7.235	.81	Trace.	.136	.04	Nona.	0.003		0.07	0.466	Pt. and Ir. traces.
Champlain	Mallum octahedrite	92.47	7.029	.604	0.013	.164	.029	Nona.	.01	Nona.	Trace.	.177	
Champlain	do.	91.21	6.01	.09	.09	.28	Trace			Nona.	0.06	.08	
Champlain	do.	93.54	6.40	.08	.08	.12	0.08			10.01	.08	.02	
Champlain	Pyrite octahedrite	91.87	7.07	.80	.08	.08	.02			.04		.06	
Champlain	Pyrite octahedrite	92.266	11.28	1.09	.08	.225	.61	Trace	.01			.026	Pt. and Ir. traces
Champlain	do.	92.15	6.46	.645	.088	.266	.029	Nona.	.003			.015	Sn (7) trace.
Champlain	do.												Pt., Pa., Ir., and Ba. traces.

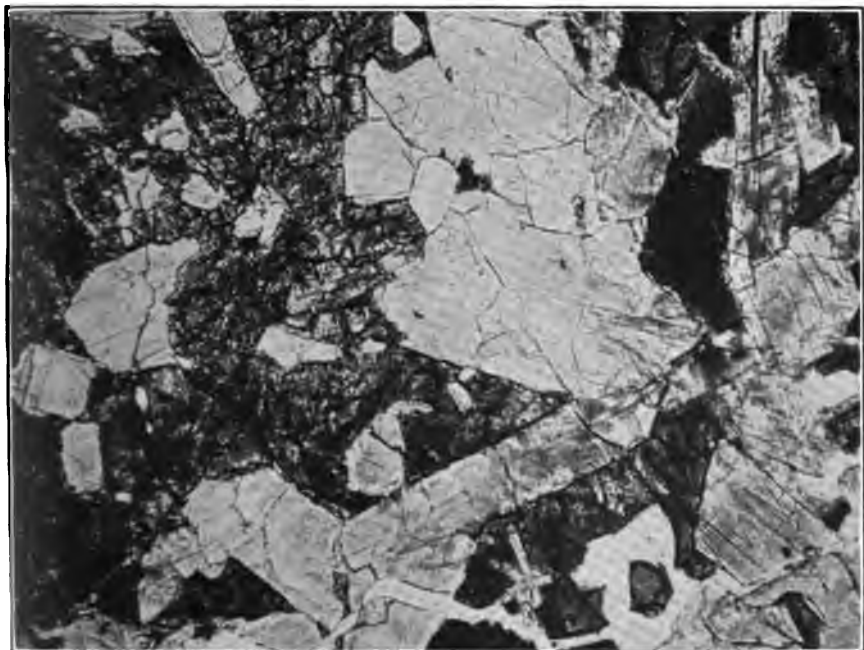
## 1 Chromite.

## METAL FROM PALLASITES.

Name	Chem.	P.	Ni	Co	Co	P.	S.	Mn	Si	Cr	Cl	C.	Misc.
Mount Vernon	Pallasite	92.28	16.044	0.940	0.104	0.260	0.266	0.121	0.200	0.200	Trace.	0.6	Va. trace.
Kramersbach	do.	92.89	9.52	.66	Nona.	.066	Nona.	Nona.					

## METAL FROM STONY METEORITES.

Name	Chem.	P.	Ni	Co	Co	P.	S.	Mn	Si	Cr	Cl	C.	Misc.
Champlain	Sphalerite-hexahedrite	92.70	6.267	0.277	0.04	0.07	Trace	0.08	0.129	0.16		0.088	
Champlain	Carbonaceous chondrite	92.44	6.26	0.15		.08		.04					



1



2

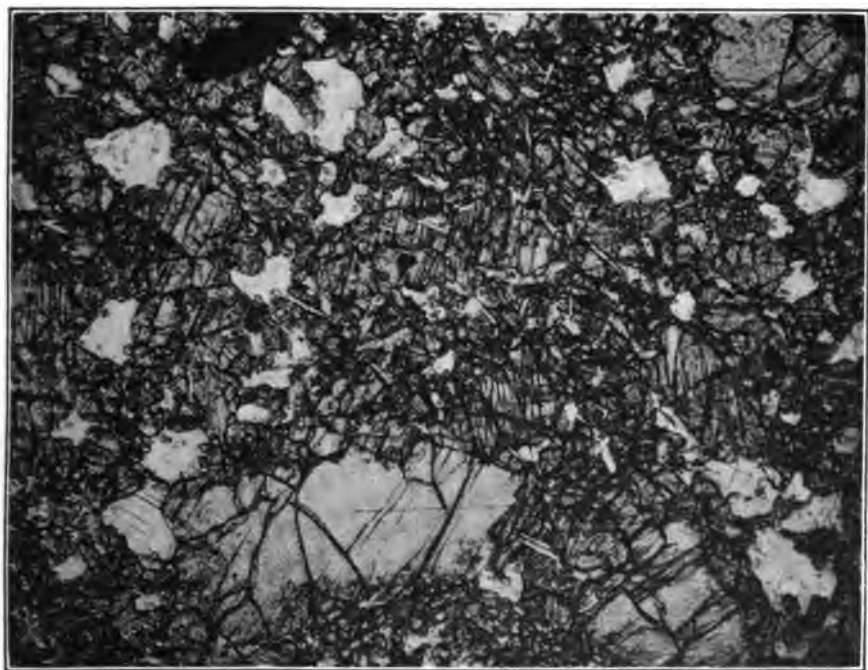
**MICROSTRUCTURE OF (1) JUVINAS AND (2) SHERGOTTY STONES.**

FOR DESCRIPTIONS SEE PAGE 17.





1



2

**MICROSTRUCTURE OF (1) EL NAKHLA STONE AND (2) ESTHERVILLE MESOSIDERITE.**

FOR DESCRIPTIONS SEE PAGES 17 AND 18.





## STRUCTURE.

As noted under the head of Classification, meteorites fall into three general groups: (1) Metallic, in which the structure is due to the varying crystallization of metallic alloys; (2) the stony-irons or siderolites, which consist of a more or less connected mesh or sponge of metal inclosing silicates, the structure of the metallic portion being essentially the same as those which are all metallic; and (3) the stony forms, which vary from holocrystalline or basaltic types to those which are fragmental and tufaceous. It is in this last group, and with particular reference to their included chondrules, that meteorites depart most widely from known structures in terrestrial rocks.

The crystalline structure of the purely metallic forms has been sufficiently dwelt upon under the head of the *Metallic constituents* of meteorites, and may be best comprehended by referring to Plates 12, 14, and 16. That of the stony-irons is shown in Plates 9 and 28. It is to be noted that there are two widely distinct types of the latter, one in which the included silicates have apparently undergone quiet crystallization even to the extent of development of recognizable crystalline facets, and the other in which the silicates, after crystallization, have become shattered and in which the metal serves as a cement or binding constituent to the angular particles. This type of structure or brecciation is well shown in the Admire pallasite (pl. 9, fig. 2), in which the dark portions are olivine and the light metal. This figure is about natural size. An enlarged portion of a metalliferous area is shown in figure 1 of the same plate. In this the dark outer portion is again olivine and the light (1) metal. The dark interior area (3) is a spongy aggregate of iron with inclosures of lawrencite and troilite. The acicular forms (4) extending into this sponge are of nickel iron. Between the nickel iron (1) and the spongy portion is commonly a thin plate of schreibersite (2) which can not be differentiated in the illustration.

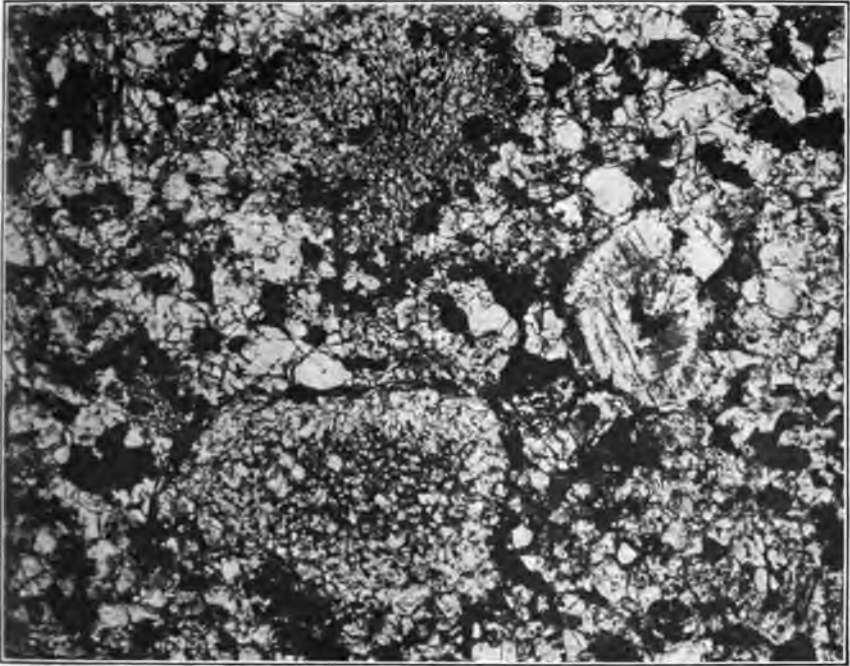
The microscopic structure of stony meteorites of the holocrystalline type most nearly resembling terrestrial rocks of the basalt, pyroxenite, or peridotite group is shown in Plates 2 and 3. In the eukrite of Juvinas (pl. 2, fig. 1) will be noted the elongated or plagioclase feldspars in a crystalline granular ground of olivines and pyroxenes, as in the gabbros, with metal in the interstices. In figure 2, from the stone of Shergotty, the structure is more nearly that of a diabase or basalt, consisting of large plates of pyroxene in a light ground, which, in this case, is isotropic, the so-called maskelynite, supposed to be a fused feldspar. In figure 1 of Plate 3 is shown the structure of the recently fallen stone of El Nakhla. This consists of a crystalline aggregate of green pyroxene and in small quantities a reddish-brown

olivine with a little interstitial feldspar, and scattering granules of titanite iron and chromite. The structure is comparable with that of a terrestrial pyroxenite. In figure 2 is shown that of the holocrystalline siliceous portion of the mesosiderite of Estherville, Iowa, consisting of olivine, orthorhombic and monoclinic pyroxene, and a plagioclase feldspar.

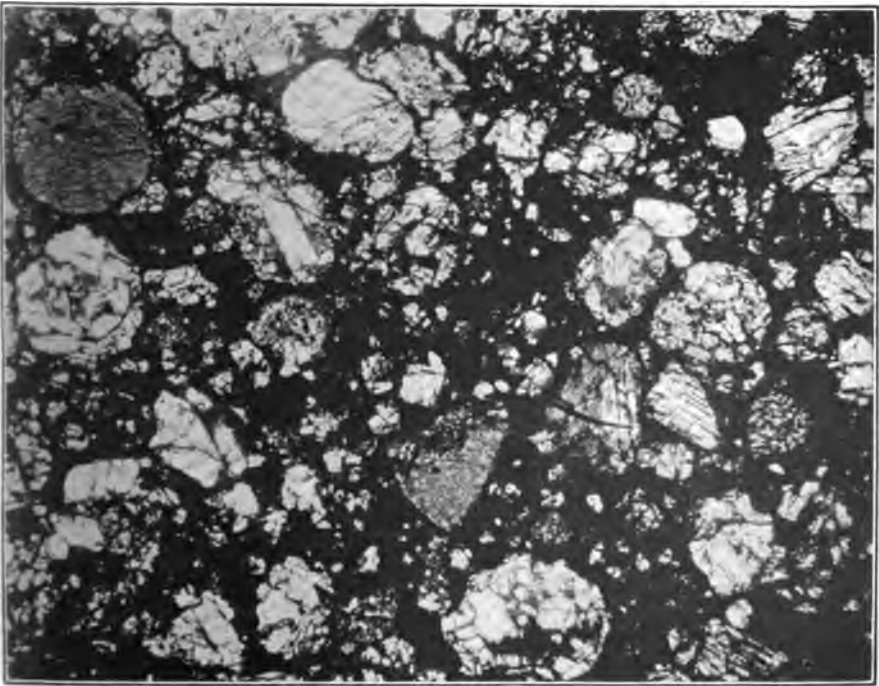
A very large portion of the stony meteorites consists wholly or in part of rounded and oval granules called chondrules, embedded in a crystalline or tuffaceous ground, and it is in these forms, both in relation to structure of the spherules themselves and the ground in which they are embedded, that interest chiefly centers. (See pls. 4, 5, and 6.) Figure 1 of Plate 4 shows the structure of a crystalline chondrite from Estacado, Texas. This, as will be observed, consists of the rounded and irregular chondrules embedded in a crystalline ground. Figure 2 of this same plate shows a tuffaceous form from Selma, Alabama, a stone consisting of chondrules in all degrees of preservation down to mere fragments embedded in a tuffaceous ground.

The individual chondrules occur in a surprising number of forms. Borgström and Ramsay enumerate 19 types of composition and structure in the stone of Bjurböle, and it is a safe assumption that this large number could be recognized in others should a sufficiently detailed study be made. In shape they vary from almost perfect spheres (pl. 5, fig. 1), often with a slight indentation on one side, through oval and elongated, rarely angular (unless fragmental), forms. Internally they may be of glass, crypto- or holo-crystalline, with a radiate, barred, or grate-like structure, of single or many individuals imbedded in a glassy or fibrous base. Occasionally they show a border of later formed crystals as in figure 5 of Plate 5. In some instances chondrules in a more or less perfect condition make up almost the entire mass of the stone as in the case of that of Allegan, Michigan, or Selma, Alabama (pl. 4, fig. 2). Or, again, they may be few and scattered throughout a crystalline ground, as in the case of the stone of Estacado, Texas (pl. 4, fig. 1). They may be so loosely attached as to fall away when the stone is broken, or so firmly imbedded as to break with it. Olivine (or forsterite) and pyroxene, either enstatite or a monoclinic form, are the more common constituents, more rarely feldspars. A border of nickel-iron or iron sulphide about a chondrule is not uncommon, the metal sometimes penetrating more or less into the interior (pl. 6, fig. 1).

*Origin of the chondritic structure.*—H. C. Sorby, writing in 1877, advanced the idea that the individual chondrules were originally detached molten drops like fiery rain and their internal crystalline or amorphous condition due to conditions of cooling. Reichenbach, as



1

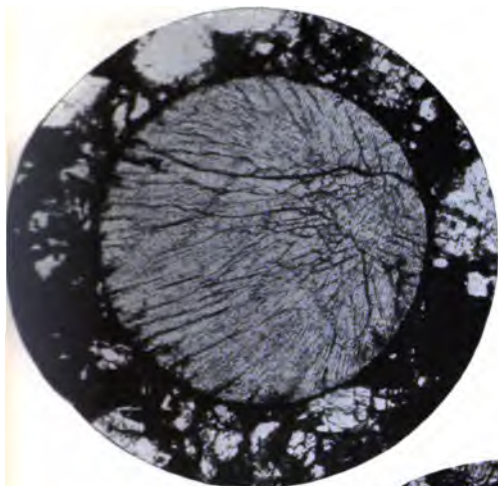


2

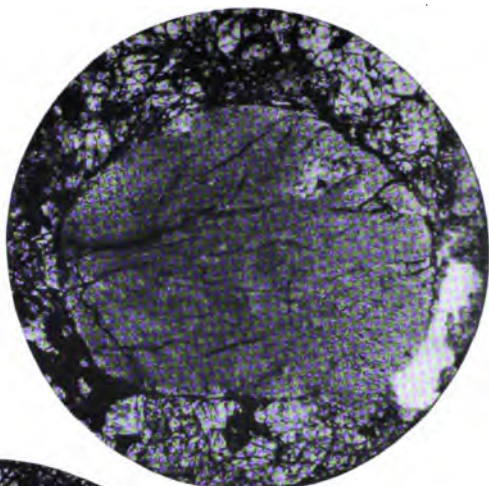
**MICROSTRUCTURE OF (1) ESTACADO AND (2) SELMA STONES.**

FOR DESCRIPTIONS SEE PAGE 18.

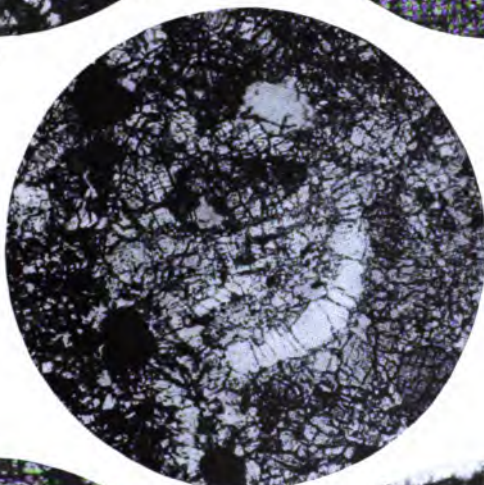




1



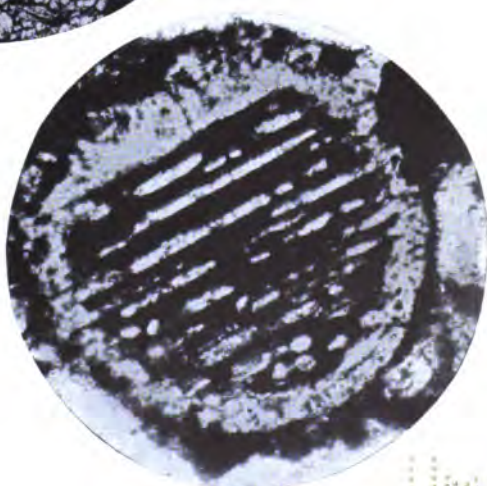
2



3



4



5

**MICROSTRUCTURE OF (1) ENSTATITE CHONDRULE IN ELM CREEK STONE, (2) ENSTATITE CHONDRULE IN HENDERSONVILLE STONE, (3) ENSTATITE CHONDRULE IN COON BUTTE STONE, (4) ENSTATITE CHONDRULE IN TENNASILM STONE, (5) BARRED OLIVINE CHONDRULE IN BEAVER CREEK STONE.**

FOR DESCRIPTIONS SEE PAGE 18.

4

quoted by Lockyer, believed each chondrule to have been an "independent crystallized individual," a stranger in its host, and imbedded like a shell in limestone. Tschermak compared the chondrules to the spherulitic forms occurring in the trachytic tuffs of Freudenthal, and more especially to the olivine spherules of Kapfenstein and Feldbode in Styria. These tuffs he thought to be due to trituration in the volcanic throat. Writing with especial reference to the Gopalpur stone, he argued that it must be considered to have been a cooled mass, which through friction was broken into powder, the more tenacious particles remaining as kugels which were again gathered into a loose aggregate. Reusch also considered the chondrules as developed in the Tysnes meteorite due largely to attrition of consolidated particles, though perhaps modified to some extent by the corrosive action of the iron. He would account for the structure of the bronzite kugels, in which the radial point lies without the periphery, by assuming that originally they all had a like conical form such as is common in radiating nodular pyrite, the upper surface of the nodule forming the base of the cone. When such were worn down by attrition the point would naturally break away. Berwerth has also arrived at the conclusion that the chondritic meteorites originate through the partial refusion of meteoric tuffs. Brezina, and after him, Wadsworth, seem to have considered the structure of meteorites in general, and incidentally that of the chondrules, as due to hasty crystallization, a conclusion which so far as it relates to certain types seems well founded. Still other suggestions have been offered, as through condensation of vapor, or the refusion of original garnets. Concerning the last, it may be said that it merits no serious consideration. The views of the present writer were presented in detail in his description of the stone of Allegan, Michigan, in 1900, and it will be sufficient to repeat here the substance of the matter there given.

The general structure of stones of the Allegan type can be accounted for only by regarding them as agglomerates of chondrules imbedded in a fragmental groundmass or matrix, the materials for which were derived from the trituration of other chondrules. One fact which has always militated against a theory which would account for the peculiar structure of a meteorite of this type, on the assumption of hasty crystallization, has been the absence of a glassy base in any but the chondritic portions. Obviously if the stone were a product of crystallization, in mass, the chondrules would be products of the earliest consolidation, and should, judged by the standard of terrestrial petrography, be the most highly crystalline, while the base in which they are imbedded might be glassy or crystalline, according to conditions. As a matter of fact, the reverse is the case, the chondrules being more or less glassy, or at least imperfectly crystallized, as in the barred and fan-shaped forms, while the ground-

mass of the stone is of crystalline particles and of particles of the chondrules themselves.

That certain conditions of crystallization would give rise to spherulitic forms of the enstatite is undoubted. The subject of their development in liparite has been worked out by Cross and Iddings,<sup>1</sup> and while it is easy to conceive of the abrupt transition from a wholly or partly crystalline spherule to a glassy base, as sometimes seen in the spherulites of obsidian, it will, in the present state of knowledge, puzzle any petrographer to account for an equally sharp transition from a glassy spherule (chondrule) to a base composed wholly of crystalline particles, as shown in many meteorites. Even could one account for such anomalies of crystallization as these, the presence of plainly fragmental chondrules—chondrules which were fragments at the time of the final consolidation of the stone—would still remain to be explained. That many of the chondrules in this stone were the results of earlier fracturing is shown conclusively by the dull and abraded character of the fractured surface. With reference to the porphyritic forms in the glassy and fibrous ground, shown by some of the chondrules, one can assume that after the phenocrysts had become secreted the magma was resolved into spherical drops which cooled too rapidly for further crystallization, while in the radiated forms crystallization may have taken place in some cases prior to the assumption of the globular form, and in some subsequent thereto. Such forms lend support to the theory of Sorby, already quoted. It is possible to conceive that these, first as blebs of molten matter and then as consolidated particles, may have been triturated in the deep throat of some volcano. The spherical form, however, is not regarded by the present writer as due to trituration like volcanic lapilli, but rather to a previous molten condition. While it may be possible to account for the present condition of the chondritic meteorites, as regards degree of consolidation, on the theory that they are tuffs more or less metamorphosed by high temperatures, the chondrules can not themselves be thus accounted for, since a heat sufficient to render crystalline the pisolites in a tuff, as argued by some, would certainly produce a more marked degree of metamorphism in the surrounding matrix. There is apparently no escape from the idea that so far as the spherical chondrules are concerned, they are independently formed, though, it may be, greatly corroded and mechanically abraded prior to their ingathering into the stony masses coming to earth from space. That many of the external forms now presented are due to mechanical causes is self-apparent, and it is possible that not all have a common origin.

*Other structural features.*—The position occupied by the metallic constituent in a stony meteorite or pallasite is such as to indicate

---

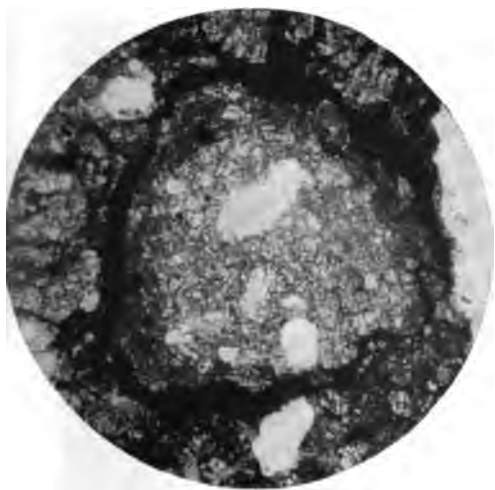
<sup>1</sup> Bull. Philos. Soc. Washington, vol. 11, 1891.



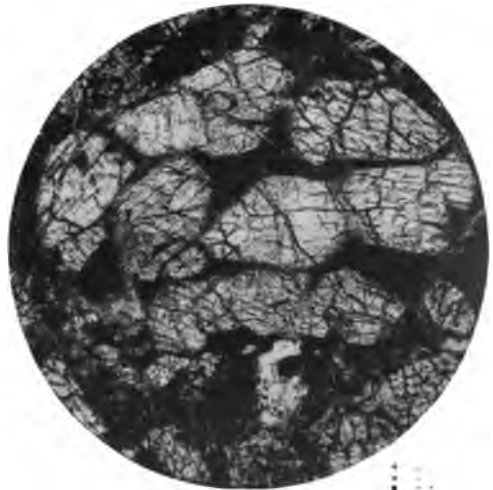
1



2



3

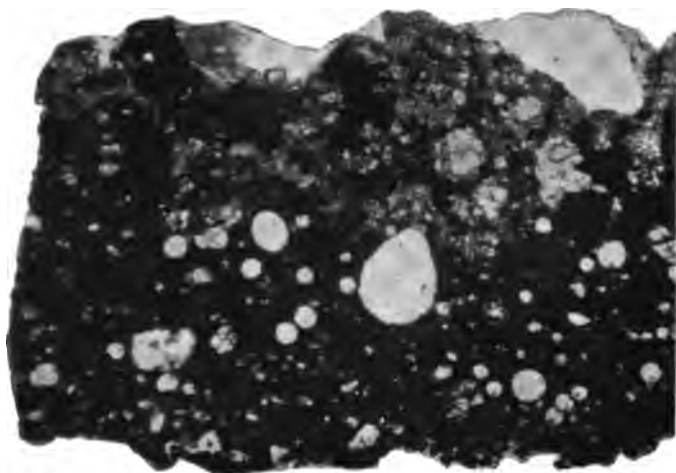


4

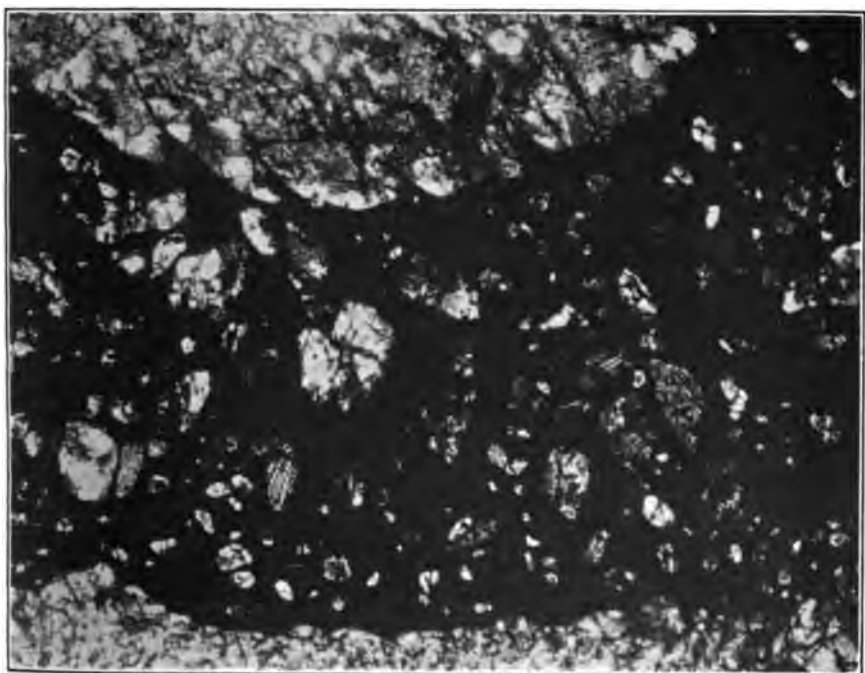
CHONDRITIC STRUCTURES IN (1 AND 4) CULLISON, (2) TENNASILM, AND (3) PARNALLEE STONES.

FOR DESCRIPTIONS SEE PAGE 18.

44



1



2

MICROSTRUCTURE OF (1) BLACK CRUST ON ALLEGAN STONE AND (2) OF BLACK VEIN IN BLUFF STONE.

FOR DESCRIPTIONS SEE PAGE 21.

Digitized by Google

plainly its secondary origin or introduction after the consolidation of all other constituents except the sulphides. While its melting point (about 1,500° C. or 2,732° F.) is somewhat lower than that of the associated silicates, the manner in which it frequently penetrates the fractures of these constituents (see *Admire pallasite*) is so strikingly like that of the native copper in the siliceous breccia of the Lake Superior region as to suggest that it results not from a condition of dry fusion, but rather from the reduction of some easily reducible iron-rich compound like *lawrencite*. Such a reduction, as noted by *Nordenskiöld*<sup>1</sup> and others, must have taken place outside of our atmosphere and in an atmosphere deficient in oxygen. It may be noted, incidentally, that the average amount of metallic iron in stony meteorites, as shown by *Merrill*, is 11.98 per cent, which is equivalent to 16.55 per cent of magnetite or 27.16 per cent of purely ferrous *lawrencite*.

The black crust coating the surface of the stony meteorites is, as already noted, a more or less perfect glass, due to the fusion of the various constituents from the heat generated during the passage of the stone through the atmosphere. This, as shown in thin section (see pl. 7, fig. 1), is rarely of more than a few millimeters in thickness. It consists, as in the case of the *Allegan stone* figured, of a "black glass interspersed with numerous residuary particles of unfused silicates, which passes down gradually into the unaltered granular stone. Sections of the thick blebby glass from the lower surface show air vesicles and numerous crystallites imperfectly secreted from the glassy base, and too small to be seen in the figure, together with the residuary unfused particles of the original minerals."

Many of the stony meteorites are traversed by small, black, thread-like veins, which are plainly due to a fracturing of the stone prior to its entrance into our atmosphere. A greatly enlarged section of one of these from the *Bluff, Fayette County, Texas, meteorite* is shown in figure 2, Plate 7. The filling material of the vein is of a nearly coal black color, opaque, and of an undetermined nature, while the white and gray particles are fragments of the minerals composing the body of the stone. Occasionally a slight movement between the walls of these veins has developed a structure known as *slickensides* in terrestrial rocks. In the illustration shown no such movement has taken place, and it will be noted that the black vein material penetrates into the walls in the form of small veinlets on either hand.

One other feature which may be mentioned is the occurrence of a colorless, limpid, interstitial mineral, nearly or quite isotropic, which forms one of the principal constituents of the meteorite of *Shergotty*,

<sup>1</sup> *Zeits. d. D. geol. Ges.*, 1881, p. 25.

but quite common in small, microscopic quantities in other stones. This has been regarded by Tschermak as a fused feldspar, though others have considered it a distinct mineral species allied to leucite. The index of refraction supports the view of Tschermak. It occurs filling interstices, without form of its own, and is apparently one of the last, if not the last, constituent to assume a solid condition.

It has been shown by Messrs. Allen and others<sup>1</sup> of the Geophysical Laboratory, that an orthorhombic pyroxene, like enstatite, may be transformed into a monoclinic form by heating to a high temperature, and, further, that the parallel growths of the two varieties, so characteristic of meteorites, can be reproduced by rapidly cooling a molten mass of pure magnesian silicate. The more rapid the cooling the greater the preponderance of the monoclinic form. It seems probable that further study of the association of the two, as seen in thin sections, will lead to interesting and important developments in the preterrestrial history of meteoric stones.

#### EARLY RECORDS AND OPINIONS REGARDING METEORITE FALLS.

There was at first, and very naturally, a great deal of scepticism shown by both the popular and scientific minds regarding the possibilities of stones falling from space. So great was this scepticism that, as stated by Chladni in his celebrated work published in 1819, the examples preserved in public museums were hidden or discarded, the custodians fearing to make laughing-stock of themselves through acquiescing in the possibility of their extra-terrestrial origin. In the few early recorded cases where meteorites were seen to fall and recovered, they were regarded as objects of reverence and worship. A stone which fell in ancient Phrygia in Asia Minor about 200 years before Christ was worshiped as Cybele, the mother of the gods. Another, of which the history goes back to the seventh century, is still preserved at Mecca where it is built into the northeast corner of the Karaba and revered as one of the holiest of holy relics. The great Casas Grandes iron (pl. 15), in the national collections at Washington, was found in an ancient Mexican ruin swathed with mummy cloths in a manner to indicate that it was held in more than ordinary veneration by the prehistoric inhabitants. Meteoric iron has been found also upon a brick altar in prehistoric ruins in Ohio, and it is on record that a stone weighing about a pound, which fell in East Africa in 1853, was secured by the natives, anointed with oil, clothed, decorated, and finally installed in a specially prepared temple.

The earliest known undoubted meteorites still preserved are those of Elbogen, Bohemia, and Ensisheim, Upper Alsace, Germany, the first mentioned an iron, the second a stone. The iron was found some-

---

<sup>1</sup> Amer. Journ. Sci., vol. 22, 1906, pp. 385-438.

where about the year 1400 of our era, but its meteoric nature seems not to have been fully established until 1812. It has, however, for several hundred years been preserved in the Rathhaus at Elbogen. The Ensisheim stone was seen to fall on November 16, 1492, between the hours of 11 and 12 in the forenoon, the fall being accompanied with a loud crash like thunder, heard for a great distance. On striking the ground the stone buried itself to a depth of some 5 feet. When exhumed, it weighed 260 pounds, the portion now remaining weighing some 155 pounds. (See No. 506.)

Occurrences so well authenticated as the last would, it seems, have gone a long way toward convincing the scientific world, at least, but such was not the case, and as late as 1772, a committee, one of whom was the celebrated chemist, Lavoisier, presented to the French Academy a report on the examination of a stone seen to fall at Lucé, four years previously. In this they took the ground that the supposed sky stone was but an ordinary terrestrial rock that had been struck by lightning.

In 1794, E. F. F. Chladni, a German scientist, brought together all available accounts of the supposed meteorites, calling the attention of the scientific world to the fact that several masses of iron had in all probability come to our earth from outer space. He referred especially to the now well-known Pallas iron, which was found by a Cossack in 1749, among schistose rock, and in the highest part of a lofty mountain near Krasnojarsk in Siberia. It was regarded by the native Tartars as a holy thing fallen from heaven, which fact would certainly seem to indicate that it was seen to fall. Chladni argued that this iron could have been formed only under the influence of fire. The absence in the vicinity of scorise, the ductility of the iron, the hard and pitted surfaces, and the regular distribution of the included olivine, to his mind precluded the idea that it could have been formed where found, or by man, electricity, or an accidental conflagration. Hence, he inferred that it had been projected from a distance, and, as there were no volcanoes known to eject iron and as, moreover, there were no volcanoes in the vicinity, he was compelled to look for an extraneous source, and to regard it as actually having fallen from the sky. Incidentally, he argued, the flight of such a body through the atmosphere would give rise to all the phenomena of the fireball or shooting star.

It was, as has been remarked, as if to direct attention to Chladni's work that there occurred during this same year an observed shower of meteoric stones near Siena, Italy. In December of the following year also a 56-pound stone fell out of a clear sky almost at the feet of a laborer near Wold Cottage in Yorkshire, England, and again in 1798, under similar conditions, many stones fell at Krakhut, near Benares, in India.

The scientific mind was, however, slow in accepting these proofs. Fortunately there occurred about this time (April, 1803) a shower of stones, upward of 3,000 in number, in the neighborhood of L'Aigle near Paris. The circumstances of this fall were fully investigated under the auspices of the French Academy of Sciences, the report of which was of so conclusive a nature as forever to set at rest all doubts concerning their extra-terrestrial origin.

#### PHENOMENA OF FALL.

The fall of a meteorite is usually accompanied by noises variously described as resembling the fire of musketry, cannonading, or even thunder. If the fall takes place during periods of darkness it is also accompanied by a flash of light and followed by a luminous rocket-like trail. These phenomena are due to the rapid passage of the objects through the air, and the consequent rise in temperature which is sufficient to produce fusion of the outer surface and even ignition, thus giving rise to the thin, dark, glass-like crust which is found coating all stony meteorites. The time of passage through the atmosphere is, however, too short to permit the heat to penetrate to great depths, and nearly all meteorites are quite cool, or scarcely warm, on reaching the surface of the ground. It is to the sudden rise in temperature and pressure of the atmosphere, too, that is due the breaking up of a meteorite and its reaching the earth as a shower of fragments rather than a single individual.

We have little to guide us in estimating the speed at which a meteorite reaches the earth and its consequent power of penetration. The velocities as given by various observers vary between 2 and 45 miles a second. These last, however, are the initial velocities, the velocities possessed by the meteors on entering our atmosphere and while still at considerable altitudes—in some instances 50 or 60 miles—and which become very materially reduced by atmospheric friction long before reaching the earth. Indeed, from the calculations of Schiaparelli and others, it is commonly assumed that a meteorite reaches the surface at the speed of an ordinary falling body. A. Herschell, as quoted by Flight,<sup>1</sup> calculated the velocity of the Yorkshire (England) meteorite at the time it reached the ground as but 412 feet a second. The Guernsey (Ohio) meteorite was estimated by Prof. E. W. Evans<sup>2</sup> to have reached the earth while traveling at a speed of 3 or 4 miles a second; that of Weston, Connecticut, while at a height of some 18 miles, was estimated by Prof. Bowditch<sup>3</sup> to have a velocity of 3 miles a second. Newton<sup>4</sup> calculated

<sup>1</sup> A Chapter on the History of Meteorites, 1887, p. 219.

<sup>2</sup> Amer. Journ. Sci., vol. 32, 1861, p. 30.

<sup>3</sup> Mem. Amer. Acad. Arts and Sci., vol. 3, 1815, p. 213.

<sup>4</sup> Amer. Jour. Sci., vol. 33, 1862, p. 338.

the speed of the fireballs which passed over the Ohio and Mississippi Valleys in August, 1860, at 30 to 35 miles a second, and stated<sup>1</sup> that the Stannern, Moravia, stone came into our atmosphere with a velocity of 45 miles a second. These higher velocities are, doubtless, those of bodies pursuing a retrograde course about the sun.

The evidence afforded by actual falls and impacts is extremely contradictory. Nordenskiöld states that, in the case of the Hessle fall, stones so friable as to be readily broken if simply thrown against a hard surface were not broken or even scarred on striking the frozen ground. Stones weighing several pounds which struck on ice a few inches in thickness rebounded without breaking the ice or being themselves broken. The 70-pound stone that fell at Allegan, Michigan, in 1899, penetrated the sandy soil to a depth of about 18 inches and was itself considerably shattered. Like that of Hessle, this was an unusually friable stone. It is evident that its speed did not exceed that of a projectile from an old-time piece of heavy ordnance. The 260-pound stone that fell at Ensisheim, Germany, in 1492, is reported to have buried itself to a depth of 5 feet.

The greatest depth of penetration of a meteoric stone which has come under the writer's observation is that of Knyahinya, Hungary, as described by Haidinger. In this instance a 660-pound stone, striking the ground at an angle of some 27° from the vertical, penetrated to a depth of 11 feet. The hole was nearly circular in outline, and fragments from the interior were thrown back and scattered to a distance of some 180 feet (*dreissig Klafter*). The stone was found broken in three pieces, and the earth beneath it compacted to stony hardness.

On the other hand, still heavier masses have been found under such conditions as to lead one to infer they scarcely buried themselves. Peary's giant Cape York iron, weighing 37½ tons, was found only partially covered; but, as it lay on a bed of gneissic boulders, this is not strange. It should be remarked, however, that an examination of the iron reveals no such abrasions of surface as might be expected had it fallen with a speed of miles per second, or, indeed, any abrasions whatever that can be ascribed to such a cause. It is, of course, possible that this fall took place when the ground was deeply covered with ice and snow, and its speed was thus checked before coming in contact with the stony matter.<sup>2</sup>

The Willamette iron, weighing 15.6 tons, seemingly lay without question as it originally fell, and in a region of no appreciable erosion—rather, one of organic deposition, for it was found lying in a

<sup>1</sup> Amer. Journ. Sci., vol. 36, 1888, p. 11.

<sup>2</sup> It is stated that lead bullets from a modern rifle may be completely checked in traversing a few feet of light snow, and this, too, without the slightest appreciable deformation or surface abrasion.

primeval forest; yet the mass was not deeply buried, a small projecting portion leading to its discovery.

The Bacubirito iron, weighing at a rough estimate 20 tons, lay in a soft soil, with its surface but little below the general surface of the field around it.

It is a noteworthy fact that the members of different meteor showers exhibit visible features which in certain cases are quite dissimilar. This arises from the circumstance that the various showers encounter the earth at different angles, and their apparent speed depends in a great measure upon this. Thus the meteors of November 13 (Leonids) are moving in a direction opposite to the earth; hence their velocity is very great, being about 44 miles per second. But the meteors of November 27 (Andromedes) are moving in nearly the same direction as the earth, and hence have to overtake us, so that they apparently move very slowly, their speed being only 11 miles per second. The Leonids above referred to, together with the Perseids of August 10 and the Orionids of October 18-20, are good examples of the swift-moving meteors, and they are almost invariably accompanied by phosphorescent streaks. The slow meteors, of which the Andromedes are a type, throw off trains of yellowish sparks.<sup>1</sup>

In conclusion, the result of the investigation may be said to have created a strong presumption in favor of the following general deductions:

(a) That the velocities of meteorites are materially changed by the resistance of the atmosphere, and, in general, by a fractional part of the velocity which is independent of the velocity of approach.

(b) That the superior limit for incandescence is probably about 150 miles above the earth's surface.

(c) That no iron meteor the original weight of which was less than 10 to 20 pounds reaches the earth's surface, and that when a meteor does so the temperature of its center is not in general above that of liquid air (assuming the temperature of space to be zero).<sup>2</sup>

All statements relative to the temperature of meteorites immediately after reaching the ground must be accepted guardedly owing to their extremely contradictory character. According to Haidinger, some stones which fell in Styria in 1859 continued in a state of incandescence for from five to eight seconds, and for a quarter of an hour were too hot to be handled without burning. Beinert, in his account of the Braunau iron, states that for six hours it also remained too hot to be handled. On the other hand, the Dhurmsala stone is stated to have been intensely cold when picked up immediately after falling.

The reports of the setting of fires by the falling of meteorites must also be taken with the same degree of allowance. In the cases of both the Allegan and Winnebago falls the stones struck on the dried grass, which, though pressed closely against the surfaces, was not charred in the least. Indeed, one of the Winnebago stones fell on a stack of dry straw, but without igniting it.

<sup>1</sup> Handbook of Descriptive and Practical Astronomy, by George F. Chambers, Sun, Planets, Comets, ed. 4, vol 1, p. 635.

<sup>2</sup> H. E. Wimperis, Nature (London, Eng.), vol. 71, 1904, p. 82.

Naturally the possibility of human beings and animals being struck by these falling bodies has been discussed, and several instances dating back to periods from 1511 to 1674 are mentioned in which persons were killed. It must be confessed that the absence of any recorded instances of this sort within more recent times, when the subject could be discussed more calmly, renders the occurrences open to question.

#### NUMBER OF FALLS AND WEIGHTS.

Upward of 650 falls and finds of meteorites have been reported, representatives of which have found their way into museums and private collections, and there preserved for study and investigation. These, however, constitute a very small fraction of those which actually fall and are never recovered, since it is estimated that upward of 20,000,000 strike the earth daily. These are for the most part very small, perhaps scarcely more than a grain in weight. It is interesting as well as singular that of all that have been seen to fall and have been recovered but nine are of iron. The largest known meteoric mass is that brought by Commander Peary from Cape York, Greenland. This weighed 73,000 pounds. The next largest lies in the plain near Bacubirito in Mexico, and has been estimated to weigh some 50,000 pounds, while the third is that of Willamette, Oregon, weighing 31,107 pounds. These are all iron meteorites. The largest known individual aerolite or meteoric stone is that of Knyahinya, Hungary, weighing some 550 pounds, now in the Vienna National Museum.<sup>1</sup>

It may be added, in conclusion, that all known meteorites are of an igneous nature and have yielded no traces of animal or vegetable life, although the peculiar radiating and grate-like structures of the chondrules were at one time mistaken for organic remains.<sup>2</sup>

---

<sup>1</sup> The Estacado, Texas, stone is stated to have weighed nearly 640 pounds when found, but it has since been cut up.

<sup>2</sup> O. Hahn, *Die Meteorite (Chondrite) und ihre Organismen*, Tübingen, 1880.



**PART II.**  
**DESCRIPTIVE CATALOGUE.**  
**A. MUSEUM COLLECTION.**

---

**INTRODUCTORY SERIES.**

**Series illustrative of three principal types of meteorites:**

**Meteoric stone:** Aerolite. Forest City, Iowa, Cat. No. 167.

**Meteoric stony-iron:** Pallasite. Ilimae, Chile, South America, Cat. No. 383.

**Meteoric iron:** Siderite. Toluca, Mexico, Cat. No. 347.

**Series illustrating mineral composition and structure:**

**Graphite**, out of Canon Diablo siderite, Cat. No. 476.

**Schreibersite**, out of Canon Diablo siderite, Cat. No. 475.

**Diamonds**, out of Canon Diablo siderite, Cat. No. 473.

**Nodule of amorphous carbon** in Canon Diablo siderite, Cat. No. 512.

**Troilite**, in Toluca siderite, Cat. No. 347.

**One-half of nodule of troilite** out of Canon Diablo siderite, Cat. No. 514.

**Widmanstätten figures**, cube of Casas Grandes siderite, No. 369.

**Neumann lines**, Scottsville, Allen County, Kentucky, siderite, No. 77.

**Chondrules**, out of Allegan, Michigan, aerolite, Cat. No. 515.

**Crust**, due to fusion by heat in passage through the atmosphere, Forest City, Iowa, Cat. No. 167.

**ABERT IRON.** (Locality uncertain, probably Toluca, Mexico.) No. 16.

Iron, Om. Section of mass weighing 150 grams. One face etched, showing coarse Widmanstätten figures. The original mass, weighing 466 grams, was found without label in the collection of the late Col. J. J. Abert. The structure and composition agree so completely with the Toluca irons that it seems best to so consider it, at least provisionally, rather than catalogue as an unknown as is usually done. At the time Colonel Abert was making his collection the Toluca irons were among the most common, and therefore most likely to find a place in mineral collections where a representative native iron was desired.

## ADMIRE, LYON COUNTY, KANSAS. Nos. 242, 249, 257, 258, 264, 281.

Stony-iron, Pallasite (Röckiky group of Brezina). Mass weighing 3,220 grams (original weight 5,460 grams); mass weighing 2,048 grams, cut in halves and polished; two complete individuals weighing 1,450 and 1,550 grams, oxidized; polished section showing brecciated structure, weighing 203 grams; mass weighing 6,725 grams, now disintegrated and preserved in petroleum distillate. A mass is known which weighed upward of 7,000 grams, making the weight of all that has thus far been found about 24,436 grams, and it is a safe assumption that upward of 30,000 grams must have at one time been in existence. A considerable portion of these have fallen to pieces through the oxidation of the included lawrencite and become destroyed. The polished slices in this collection have been preserved by immersion in a petroleum distillate. Mineral composition: olivine with metallic iron, scheibersite, troilite, lawrencite, and chromite. The structure is that of a siliceous breccia with a metallic cement. (See pls. 8 and 9.)

Composition of the metallic portion, as shown by Wirt Tassin's analyses:

	Per cent.
Iron (Fe)-----	93.00
Nickel (Ni)-----	6.00
Cobalt (Co)-----	.02
Sulphur (S)-----	.03
Phosphorus (P)-----	.25
Copper (Cu)-----	Traces
	<hr/> 99.30

This corresponds to:

	Per cent.
Nickel-iron-----	98.273
Schreibersite-----	1.645
Troilite-----	.082
	<hr/> 100.00

The meteorite is the third of its class thus far known. Nothing is definitely known regarding its fall, the material having been discovered by a Mr. W. Davis while plowing, and attention called to it on account of its unusual appearance, which was wholly unlike any of the local rocks of the vicinity.

*Reference.*—G. P. Merrill, Proc. U. S. Nat. Mus., vol. 24, 1902, p. 907.

## AGEN, LOT-ET-GARONNE, FRANCE. No. 231.

Stone, Cia. Three small fragments, weighing 38 grams, from a stone which fell September 5, 1814.

## AHUMADA, CHIHUAHUA, MEXICO. No. 436.

Stony-iron, Pallasite. Irregular slice some 17 cm. by 10 cm. by 15 mm., weighing 840 grams. Consists of irregular masses of olivine,



**TWO SPECIMENS OF ADMIRE PALLASITE, AS FOUND.**

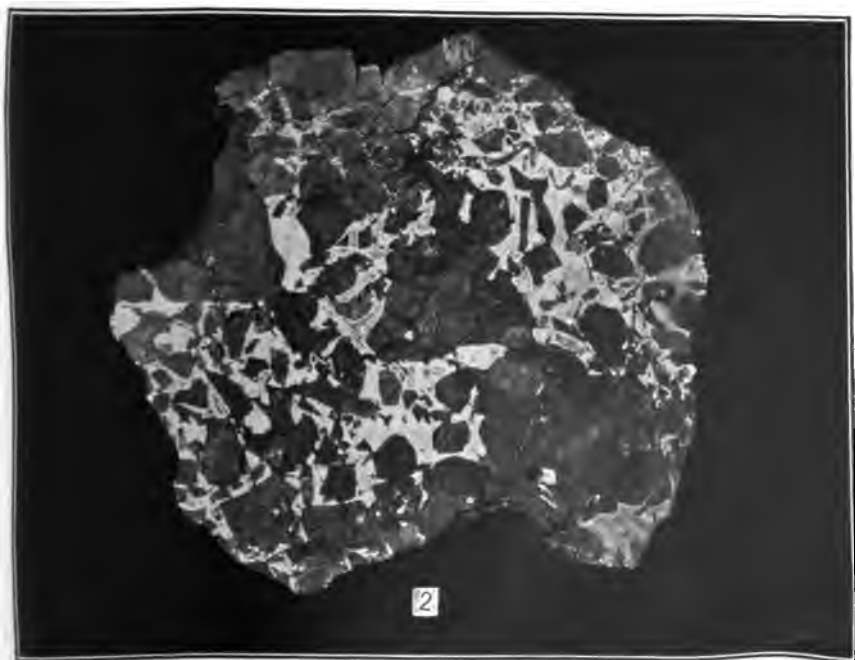
FOR DESCRIPTIONS SEE PAGE 30.



11



1

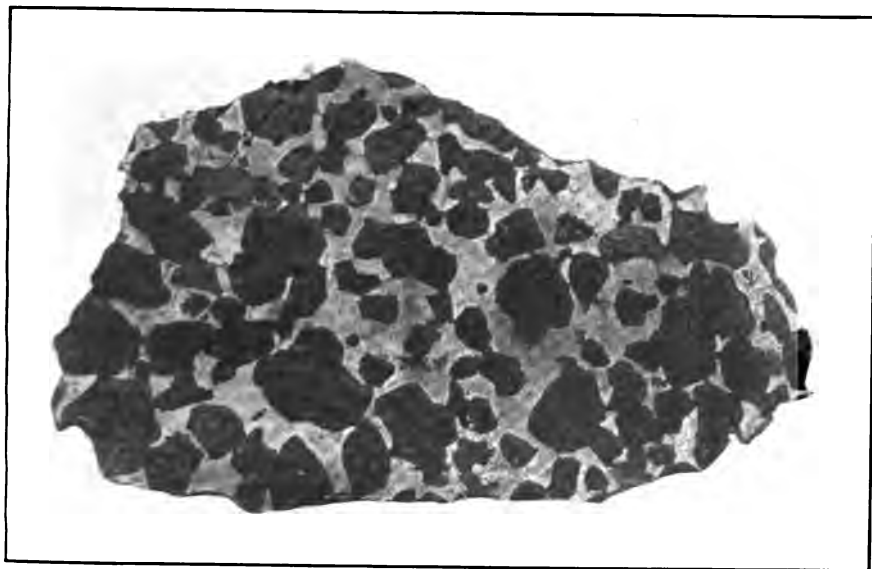


2

SECTION OF (1) METALLIC PORTION AND (2) POLISHED SLICE OF ADMIRE PALLASITE.

FOR DESCRIPTIONS SEE PAGE 30.





1



2

POLISHED SLICES OF (1) AHUMADA PALLASITE AND (2) OF AINSWORTH IRON.

FOR DESCRIPTIONS SEE PAGES 30 AND 31.



44

sometimes 2 cm. in diameter, in a coarse network of metal, with very little sulphide. Found in 1909. (Pl. 10, fig. 1.)

*Reference.*—O. C. Farrington, *Field Mus. Nat. Hist.*, Publ. 178, *Geol. Ser.*, vol. 5, No. 1, 1914, p. 1.

**AINSWORTH, BROWN COUNTY, NEBRASKA. No. 375.**

Iron, Ogg. Etched slab weighing 1,716 grams. A portion of a mass weighing 10.65 kilograms, or 23½ pounds. Remarkable for its coarse crystallization (see pl. 10). Found in 1907. Analysis by Wirt Tassin showed:

	Per cent.
Iron (Fe).....	92.22
Nickel (Ni).....	6.49
Cobalt (Co).....	.42
Copper (Cu).....	.01
Phosphorus (P).....	.28
Sulphur (S).....	.07
Chromium (Cr).....	.01
Silicon (Si).....	.049
Carbon (C).....	.09
	<hr/>
	99.639

*Reference.*—E. E. Howell, *Amer. Journ. Sci.*, vol. 25, 1908, p. 105.

**ALBUQUERQUE, NEW MEXICO. (See also Glorieta.) No. 115.**

Iron, Om. Small section showing original and etched surface, weighing 56 grams; part of a mass found in 1884, and regarded by Kunz as probably a part of the Glorieta fall. Composition according to Eakins:

	Per cent.
Iron (Fe).....	88.76
Nickel (Ni).....	9.86
Cobalt (Co).....	.51
Copper (Cu).....	.034
Zinc (Zn).....	.030
Chromium (Cr).....	Trace.
Manganese (Mn).....	Trace.
Carbon (C).....	.41
Phosphorus (P).....	.182
Sulphur (S).....	.012
Silicon (Si).....	.044
	<hr/>
	99.842

*References.*—G. F. Kunz, Further notes on the meteoric iron from Glorieta Mountain, New Mexico. *Amer. Journ. Sci.*, vol. 32, 1886, p. 311. L. G. Eakins, Meteoric iron from New Mexico. *Proc. Colo. Sci. Soc.*, vol. 2, 1885, p. 14.

**ALEPPO (HALEB), SYRIA. No. 237.**

Stone, Cwb. Section of mass, with portion of crust, weighing 167 grams, from a stone weighing 3 kilograms, supposed to have fallen

in 1873. An ash-gray groundmass flecked with rust and containing numerous metallic grains; traversed with slickensided veins.

ALFIANELLO, PROVINCE OF BRESCIA, ITALY. Nos. 71, 466, 497.

Stone, Ci. Three fragments weighing, respectively, 61.3, 134, and 17 grams, with and without crust. Showing ash-gray groundmass flecked with rust spots and carrying chondrules and metallic grains. Fell at 2.55 p. m. February 16, 1883, traveling in a south-southeast direction, but, through some unaccountable reason, burying itself obliquely in the soil to the depth of a meter in an opposite direction. The grass in the vicinity of the hole is stated to have been singed and the stone still warm when dug up. Original weight 260 kilograms.

The results of analyses as given by chemists are somewhat variable. In column I below are those of H. von Foullon, and in column II those of P. Maissen:

Constituents.	I.	II.
Silica ( $\text{SiO}_2$ ).....	39.14	37.63
Alumina ( $\text{Al}_2\text{O}_3$ ).....	.93	1.78
Ferrous oxide ( $\text{FeO}$ ).....	17.42	24.42
Magnesia ( $\text{MgO}$ ).....	25.01	23.43
Lime ( $\text{CaO}$ ).....	1.96	.89
Soda ( $\text{Na}_2\text{O}$ ).....	.75	1.09
Potash ( $\text{K}_2\text{O}$ ).....	.10	.24
Iron ( $\text{Fe}$ ).....	11.31	5.76
Nickel ( $\text{Ni}$ ).....	1.09	1.14
Cobalt ( $\text{Co}$ ).....		.08
Sulphur ( $\text{S}$ ).....	2.71	2.54
Phosphorus ( $\text{P}$ ).....		.15
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....		.10
Manganous oxide ( $\text{MnO}$ ).....		.13
	100.42	100.38

<sup>1</sup> Record also  $\text{CrO}_3$  0.629.

The mineral composition, as calculated from these analyses, is:

	Per cent.
Bronzite and feldspar (maskelynite).....	41.37
Olivine.....	43.77
Nickel-iron.....	7.66
Pyrrhotite.....	7.45
	100.25

There are present also a phosphatic mineral and granules of chromic iron.

*References.*—H. von Foullon, Sitz. Akad. Wiss. Wien, vol. 88, 1883, p. 433. P. Maissen, Gazz. Chim. Ital., vol. 13, 1884, p. 369. George P. Merrill, Proc. Nat. Acad. Sci., vol 1, 1915, pp. 302–308.

## ALGOMA POST OFFICE, KEWAUNEE COUNTY, WISCONSIN. No. 273.

Iron, Om. Two fragments weighing 4 and 12 grams, from a mass weighing a little more than 2 kilograms, found in 1887. The original iron was remarkable for its discoid shape, measuring 25 by 16½ cm. with a maximum thickness of 2¼ cm. The chemical composition, as given by Hobbs, is as follows:

	Per cent.
Iron (Fe) -----	88.62
Nickel (Ni) -----	10.68
Cobalt (Co) -----	.84
Phosphorus (P) -----	.15
Silica (SiO <sub>2</sub> ) -----	.02
Sulphur (S) -----	Trace.
Copper (Cu) -----	None.
Carbon (C) -----	None.
	<hr/> 100.26

*Reference.*—W. H. Hobbs, Meteorite from Algoma, Wisconsin Bull. Geol. Soc. America, vol. 14, 1903, p. 97.

## ALLEGAN, THOMAS HILL, ON THE SAUGATUCK ROAD, ALLEGAN COUNTY, MICHIGAN. No. 215.

Stone, Cco. Principal mass, covered, except where broken, with thick black crust (pl. 11), and many fragments. Total weight about 35.5 kilograms. Fell a little after 8 o'clock on the morning of July 10, 1899. Flight from the northeast toward the southwest. When first seen in the air (after explosion) it had the appearance of a black ball, the size of a man's hand when closed, followed by a bluish cloud apparently some six feet in length. The explosion was reported as cannon-like, and was followed by a hissing sound compared with that of an engine blowing off steam. But one mass was seen to fall, which buried itself in the sand only to the depth of 18 inches.

The chemical composition of the stone is as follows:

<b>Metallic part, 23.06 per cent:</b>	<b>Per cent.</b>
Iron (Fe) -----	21.09
Copper (Cu) -----	.01
Nickel (Ni) -----	1.81
Cobalt (Co) -----	.15
<b>Stony part, 76.94 per cent:</b>	
Silica (SiO <sub>2</sub> ) -----	34.95
Titanic oxide (TiO <sub>2</sub> ) -----	.08
Phosphoric acid (P <sub>2</sub> O <sub>5</sub> ) -----	.27
Alumina (Al <sub>2</sub> O <sub>3</sub> ) -----	2.55
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ) -----	.53
Ferrous oxide (FeO) -----	8.47
Ferrous sulphide (FeS) -----	5.05
Manganous oxide (MnO) -----	.18
Nickel oxide (NiO) -----	Trace.

Stony part, 76.94 per cent—Continued.		Per cent.
Lime (CaO)-----		1.73
Magnesia (MgO)-----		21.99
Potash (K <sub>2</sub> O)-----		.23
Soda (Na <sub>2</sub> O)-----		.66
Lithia (Li <sub>2</sub> O)-----		Faint trace.
Ignition (H <sub>2</sub> O) {	at 110°-----	.06
	above 110°-----	.19
		<hr/> 100.00

Specific gravity at 27° C., 3.905.

The mineral composition of this stone is essentially olivine and enstatite in nearly equal proportions, with 23.06 per cent nickeliferous iron and 1.3 per cent chromite. Structurally, it is chondritic and tufaceous, the chondrules showing in some cases undoubted evidences of their fragmental nature before the stone consolidated in its present form. Extremely friable; color light ash gray.

*Reference.*—Geo. P. Merrill and H. N. Stokes, A new stony meteorite from Allegan, Michigan [and a new iron meteorite from Mart, Texas]. Proc. Washington Acad. Sci., vol. 2, 1900, pp. 41–56.

**AMALIA FARM, NEAR GIBBON, GERMAN SOUTHWEST AFRICA. No. 432.**

Iron, Off. Etched slice, 25 by 15 by 6 cm., weighing 6,538 grams and showing structure indicative of the welding of three distinct masses. (See also Mukerop.)

Gift of C. S. Bement.

**ANDERSON, LITTLE MIAMI VALLEY, HAMILTON COUNTY, OHIO. No. 108.**

Stony-iron, Pallasite. Weight 15 grams. Found in "Indian mound No. 3 of the Turner Group," in the Little Miami Valley of Ohio. (Supposed to be a part of Brenham, Kiowa County, Kans.)

*Reference.*—O. W. Huntington, Prehistoric and Kiowa County pallasites. Proc. Amer. Acad. Arts and Sci., vol. 26, 1891, pp. 1–12.

**ANGRA DOS REIS, RIO DE JANEIRO, BRAZIL. No. 111.**

Stone, A. Fragment weighing 8.5 grams, with shining black crust. The fragment is interesting as representing the rare group of angrites, or stones which are composed almost wholly of the mineral augite.

**ARISPE, SONORA, MEXICO. Nos. 299, 325.**

Iron, Ogg. Two samples; an etched slab 48 by 28 by 2 cm., weighing 9,695 grams, and a complete individual weighing 52,727 grams. Found in 1898 in northeastern Mexico. Nothing known regarding fall. The slice shows an interrupted line of troilite masses, which, together with the crystallization brought out by the etched figure, indicates that it is made up of two differently oriented masses welded together. A partial analysis by Whitfield yielded: iron, 92.268;



1

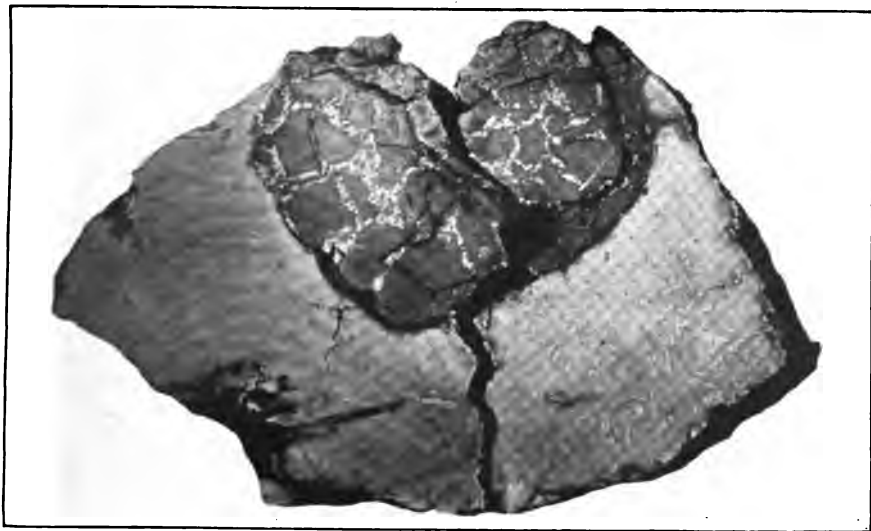


2

**POLISHED SLICE OF (1) BRENHAM PALLASITE AND (2) THE ALLEGAN METEORIC STONE,  
AS FOUND.**

**FOR DESCRIPTIONS SEE PAGES 33 AND 49.**





1



2

POLISHED SLICE OF (1) CANON DIABLO IRON AND (2) ETCHED SLICE OF ARISPE IRON.

FOR DESCRIPTIONS SEE PAGES 34 AND 51.

10

nickel, 7.040. Subsequently Dr. John M. Davison found traces of platinum. Specific gravity, 7.853. This iron is remarkable for the large masses of dendritic schreibersite it contains. (See pl. 12, fig. 2.)

*Reference.*—H. A. Ward, Proc. Rochester Acad. Sci., vol. 4, 1902, p. 79.

**ARLINGTON, SIBLEY COUNTY, MINNESOTA. No. 492.**

Iron, Om. A thin slice 60 by 20 mm. and weighing 24 grams, from a mass weighing 19½ pounds, found in 1894. An analysis by F. F. Sharpless yielded:

	Per cent.
Iron (Fe)-----	90.781
Nickel (Ni)-----	8.605
Cobalt (Co)-----	1.023
Phosphorus (P)-----	.045
	<hr/> 100.454

No sulphur, silicon, or manganese, and but traces of chromium, copper, and carbon.

*Reference.*—N. H. Winchell, Amer. Geologist, vol. 18, 1896, p. 267.

**AUBURN, LEE (FORMERLY MACON) COUNTY, ALABAMA. No. 35.**

Iron, H. Weight 23 grams. Date of fall unknown, the mass being ploughed up in a field "many years" prior to 1869. The iron as found was described by C. U. Shepard as cracked up and subdivided by open veins as if it had been shattered by striking against a rock at the time of its fall. The cohesion was so imperfect that it could be broken into small pieces by means of a sledge hammer, and a very large portion of it has been lost. The chemical composition as given is:

	Per cent.
Iron (Fe)-----	94.58
Nickel (Ni)-----	3.015
Phosphorus (P)-----	.129
Insoluble -----	.523
Chromium (Cr)-----	} 1.753
Magnesium (Mg)-----	
Calcium (Ca)-----	
Silicon? (Si)-----	
Loss -----	
	<hr/> 100.00

*Reference.*—C. U. Shepard, Meteoric iron from Auburn, Macon County, Alabama. Amer. Journ. Sci., vol. 47, 1869, p. 230.

**AUGUSTINOWKA, EKATERINOSLAW, RUSSIA. No. 224.**

Iron, Of. Weight 70 grams. Rectangular slice, 9.5 by 2.5 cm., etched and showing Widmanstätten figures. Date of fall unknown. Found 1890, buried at the depth of a meter in the loess. Original

weight 25 pfund (400 kilograms). Composition as given by Meunier:  
One gram yielded:

	Per cent.
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	0.88
Nickel oxide ( $\text{NiO}$ )	.182
Schreibersite	.088
Insoluble material	.021
	<hr/> 1.07

The iron as found was very badly oxidized, but is of interest as being probably of prediluvial age. Structure octahedral.

*Reference.*—S. Meunier, *Compt. Rend.*, vol. 116, 1893, p. 1151.

**BABB'S MILL, GREENE COUNTY, TENNESSEE. No. 98.**

Iron, Db. Weight, 38.4 grams. Date of fall unknown; found in 1842 and described by Troost in 1845; later (in 1876) a larger mass was found which was described and figured by W. P. Blake in 1886. The second find was remarkable for its peculiar shape, being 36 inches long, 10 inches broad, and 6 inches in thickness, with a girth of 24 inches. (See Cast No. 291.) It belongs to the group of structureless irons, ataxites, and shows no figures on an etched surface. The chemical composition as given by Cohen and Weinschenk is:

	Per cent.
Iron (Fe)	86.80
Nickel (Ni)	12.58
Cobalt (Co)	1.66
	<hr/> 100.54

*References.*—G. Troost, *Meteoritic iron from Green Co., Tenn.* *Amer. Journ. Sci.*, vol. 49, 1845, pp. 342–344. W. P. Blake, *Amer. Journ. Sci.*, vol. 31, 1886, pp. 41–46. Cohen and Weinschenk, *Ann. k. k. Naturhist. Hofmus.*, vol. 6, 1891, p. 142.

**BALLINOO, MURCHISON RIVER, WEST AUSTRALIA. No. 254.**

Iron, Off. Weight, 1,266 grams; etched slab 19.5 by 9 cm., showing troilite nodules. Date of fall not known. Found in 1893. Weight of original mass, 42.9 kilograms (93 lbs.). Composition:

	Per cent.
Iron (Fe)	89.909
Nickel (Ni)	8.850
Cobalt (Co)	.740
Phosphorus (P)	.501
Carbon (C)	} Traces.
Copper (Cu)	
Sulphur (S)	
Silicon (Si)	
	<hr/> 100.09
Specific gravity	7.8

Subsequent investigations have shown this iron to contain traces of palladium and ruthenium.

*References.*—H. A. Ward, Amer. Journ. Sci., vol. 5, 1898, p. 186. Geo. P. Merrill, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 596.

**BARBOTAN, LANDES, FRANCE. No. 305.**

Stone, Cga. Weight, 273 grams. Irregular fragment without crust. Dark gray, rust spotted. Fell July 24, 1790. The fall was observed over an area of many miles, the meteor appearing as a blinding white ball followed by a dark red trail. Its fall was accompanied by an explosion, the thunder-like report of which continued for three or four minutes, the fragments burying themselves in the earth to a depth of from three to five feet. Wülfing gives the known weight as 5,911 grams, of which 858 grams are in the British Museum and 618 in the Vienna Museum.

Composition: Satisfactory chemical analyses seem never to have been made. A microscopic study by Tschermak showed it to have an indistinct chondritic structure and to consist of bronzite and olivine with nickel-iron and troilite. The stone is of more than usual interest, being one of the early well-authenticated falls.

*Reference.*—H. Pfahler, Min. pet. Mitth., vol. 18, 1893, p. 353.

**BARRATTA STATION, 35 MILES NORTHWEST OF DENILQUIN, NEW SOUTH WALES, No. 239.**

Stone, Cgb. Weight, 451 grams; triangular fragment, with polished surface and original crust. Date of fall unknown. Three stones found, the first, weighing about 71 kilograms, in 1852, and the two others, weighing 21.77 kilograms and 14.3 kilograms, in 1889. Compact, dark gray, chondritic stones, the chondrules so large (1–5 mm.) and abundant as to give it, even to the unaided eye, a conglomerated appearance. Under the microscope a mass of more or less fragmental and distorted chondrules of olivine and enstatite, with interstitial iron and troilite. An analysis by Liversidge yielded:

	Per cent.
Silica ( $\text{SiO}_2$ ) .....	40.280
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	1.843
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ) .....	3.930
Lime ( $\text{CaO}$ ) .....	1.400
Magnesia ( $\text{MgO}$ ) .....	23.733
Manganous oxide ( $\text{MnO}$ ) .....	.734
Potash ( $\text{K}_2\text{O}$ ) .....	1.024
Soda ( $\text{Na}_2\text{O}$ ) .....	.997
Sulphur (S) .....	2.288
Iron (Fe) .....	14.966
Nickel (Ni) .....	4.219

	Per cent.
Cobalt (Co)-----	Traces.
Copper (Cu)-----	.182
Phosphorus (P)-----	.617
	<hr/> 96.213

with traces of chromium and carbon.

*Reference.*—A. Liversidge, Journ. Proc. Royal Soc. New South Wales, vol. 16, 1883, p. 31; vol. 36, 1902, p. 350.

**BATH, BROWN COUNTY, SOUTH DAKOTA. Nos. 201, 276.**

Stone, Ccb. Weights, 25 and 687 grams. Fragments with crust and polished surface. Crust dull black, papillated and somewhat blebby. Groundmass ash gray, flecked with rust and containing chondrules and metallic particles. Fine, granular, compact. Fell about 4 p. m. on August 29, 1892, the fall being witnessed by two men. Stone buried itself in the ground to a depth of 16 inches and was still warm when dug up. Apparently has never been analyzed. Original weight, 21.2 kilos, or 46½ pounds.

*Reference.*—A. E. Foote, Amer. Journ. Sci., vol. 45, 1893, p. 64.

**BATH FURNACE, KENTUCKY. No. 302.**

Stone, Cia. Triangular fragment weighing 323 grams. Fragment of a stone which fell in the early evening of November 15, 1902. Three masses were found—one weighing 5.8 kilograms or 12 pounds, 12½ ounces, the second weighing 223 grams and the third 80.57 kilograms, or about 177 pounds. The last mentioned, now in the Field Museum at Chicago, is remarkable on account of the perfection of its strongly fluted surface. It has not been analyzed.

*Reference.*—H. A. Ward, Proc. Rochester Acad. Sci., vol. 4, 1905, p. 193.

**BEAR CREEK, DENVER COUNTY, COLORADO. No. 60.**

Iron, Of. Weight 25 grams. Thin slice 3.7 by 2.8 by 4 cm. Polished and etched showing Widmanstätten figures. Taenite plates very distinct. Date of fall unknown. Found and described in 1866. Composition as determined by J. L. Smith:

	Per cent.
Iron (Fe)-----	83.89
Nickel (Ni)-----	14.06
Cobalt (Co)-----	.83
Copper (Cu)-----	Trace
Phosphorus (P)-----	.21
	<hr/> 98.99

Smith also determined the presence of schreibersite and pyrrhotite, the latter of which yielded on analysis:

	Per cent.
Sulphur (S) .....	35.08
Iron (Fe) .....	61.82
Nickel (Ni) .....	.41
Insol. residue .....	1.81
	<hr/> 99.12

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 44, 1867, p. 66.

BEAVER CREEK, WEST KOOTENAI DISTRICT, BRITISH COLUMBIA. Nos. 170, 342.

Stone, Cck. Two pieces weighing 330 and 369 grams. Fragments with dull black papillated crust; from a stone which fell between 3 and 4 o'clock on the afternoon of May 26, 1893; flight from the west toward the east; fall preceded by sharp report heard for a distance of 25 miles. Stone broke in two pieces, the largest of which, weighing 14,000 grams, buried itself in the earth for a distance of about 3 feet, the direction of the hole being at an angle of about  $58^\circ$  with the horizon. Chemical composition: The metallic portion yielded:

	Per cent.
Iron (Fe) .....	90.68
Nickel (Ni) .....	8.80
Cobalt (Co) .....	.49
Copper (Cu) .....	.03
	<hr/> 100.00

The silicates; divided into soluble and insoluble portions, as usual, yielded:

Constituents.	Soluble portion.	Insoluble portion.
Silica ( $\text{SiO}_2$ ) .....	38.26	57.75
Titanic oxide ( $\text{TiO}_2$ ) .....		.18
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	.56	4.89
Ferrous oxide ( $\text{FeO}$ ) .....	19.52	8.02
Nickel oxide ( $\text{NiO}$ ) .....	.09	Trace.
Manganous oxide ( $\text{MnO}$ ) .....	.27	.35
Lime ( $\text{CaO}$ ) .....	1.03	3.44
Magnesia ( $\text{MgO}$ ) .....	38.73	23.19
Potash ( $\text{K}_2\text{O}$ ) .....	.02	.25
Soda ( $\text{Na}_2\text{O}$ ) .....	.13	1.87
Ignition ( $\text{H}_2\text{O}$ ) above $100^\circ$ ..	.70	.06
Phosphoric acid ( $\text{P}_2\text{O}_5$ ) .....	.68	
Chlorine (Cl) .....	Trace.	
	<hr/> 99.99	<hr/> 100.00

From these results, aided by a microscopic study, the composition of the entire mass has been calculated as follows:

	Per cent.
Silica ( $\text{SiO}_2$ )	37.14
Alumina ( $\text{Al}_2\text{O}_3$ )	2.15
Titanic oxide ( $\text{TiO}_2$ )	.07
Ferrous oxide ( $\text{FeO}$ )	10.45
Nickel oxide ( $\text{NiO}$ )	.083
Manganous oxide ( $\text{MnO}$ )	.23
Lime ( $\text{CaO}$ )	1.76
Magnesia ( $\text{MgO}$ )	23.44
Potash ( $\text{K}_2\text{O}$ )	.097
Soda ( $\text{Na}_2\text{O}$ )	.79
Water ( $\text{H}_2\text{O}$ )	.23
Phosphoric acid ( $\text{P}_2\text{O}_5$ )	.25
Iron ( $\text{Fe}$ )	15.53
Nickel ( $\text{Ni}$ )	1.51
Cobalt ( $\text{Co}$ )	.09
Copper ( $\text{Cu}$ )	.006
Troilite	5.05
Chromite	.77
Magnetite	.16
	<hr/> 99.806

The mineral composition is olivine, enstatite, metallic iron, magnetite, troilite, and chromite, with a lime phosphate and plagioclase feldspar (?) in very small quantity. The proportional amounts of these constituents are: Iron, 17.30; troilite, 5.05; chromite, 0.77; magnetite, 0.16; soluble silicates (mainly olivine) and phosphates, 37.23; insoluble silicates (mainly enstatite), 39.66.

The structure is chondritic and compact; somewhat friable; color, gray.

The 330-gram piece is the gift of Mr. James Hislop.

*Reference.*—E. E. Howell, The Beaver Creek meteorite. (Chemical work by W. F. Hillebrand, microscopic work by Geo. P. Merrill.) Amer. Journ. Sci., vol. 47, 1894, p. 430.

**BELLA ROCA, SIERRA DE SAN FRANCISCO, SANTIAGO, PAPASQUIARO, DURANGO, MEXICO. No. 142.**

Iron, Of. Weight 152 grams. Irregular mass 5 by 6 cm., containing cavity left by oxidation of large troilite nodule; one surface etched, showing Widmanstätten figures and scattering troilites. Weight of original mass 33 kilograms. Date of fall unknown. Found in 1888. Described by Whitfield, who found the metallic portion to consist of:

	Per cent.
Iron (Fe) .....	91.48
Nickel (Ni) .....	7.92
Cobalt (Co) .....	.22
Phosphorus (P) .....	.21
Sulphur (S) .....	.21
Carbon (C) .....	.06
	<hr/> 100.10

The iron was deeply pitted exteriorly. From the bottom of one of these pits was obtained material which on examination proved to be troilite, from which it was assumed that the pits were formed by the weathering out of troilite nodules.

Gift of Messrs. Ward and Howell.

*Reference.*—J. E. Whitfield, Amer. Journ. Sci., vol. 37, 1889, p. 439.

**BEMDEGO, PROVINCE OF BAHIA, BRAZIL. No. 351.**

Iron, Og. Triangular slab 11.5 by 4.5 cm., weighing 140 grams, with one large troilite nodule. The original mass as found weighed 5,370 kilograms, or 11,814 pounds, being, therefore, the fourth largest mass known. Found about 1811. Date of fall unknown.

*Reference.*—Orville A. Derby, Archiv. Mus. Nac. Rio de Janeiro, vol. 9, 1896, p. 89.

**BENARES (KRAKHUT), INDIA. No. 42.**

Stone, Cc. A 1-gram fragment from a shower which fell at Benares on December 19, 1798.

**BETHANY, GREAT NAMAQUALAND, SOUTH AFRICA. No. 489.**

Iron, Om. An end slice showing portion of original surface, weighing 127 grams, from a mass known since 1860, weighing originally some 231.84 kilograms (510 pounds). An average of two analyses by Dr. J. Fahrenhorst yielded the results in columns I and II below, I being that of the mass as a whole and II that of the nickel-iron freed from other constituents.

Constituents.	I.	II.
Iron (Fe) .....	91.68	91.485
Nickel (Ni) .....	7.975	7.885
Cobalt (Co) .....	.60	.59
Copper (Cu) .....	.025	.03
Carbon (C) .....	.015	.01
Chromium (Cr) .....	.02	.....
Chlorine (Cl) .....	.01	.....
Sulphur (S) .....	.03	.....
Phosphorus (P) .....	.06	.....
	<hr/> 100.415	<hr/> 100.000

From these the mineral composition is calculated as:

Nickel-iron.....	99.51
Schreibersite.....	.39
Daubreelite.....	.05
Troilite.....	.04
Lawrencite.....	.01
	<hr/>
	100.00

Gift of South African Museum.

*Reference.*—E. Cohen, *Ann. South African Mus.*, vol. 2, 1900, p. 21.

**BIALYSTOCK, RUSSIAN POLAND. No. 332.**

Stone, Ho. A 21-gram fragment from a shower weighing altogether some 2 kilograms, which fell on October 5, 1827.

**BILLINGS, CHRISTIAN COUNTY, MISSOURI. No. 444.**

Iron, Om. Slice 70 by 175 mm., weighing 440 grams. Found in 1903. Date of fall unknown. Chemical analysis by H. W. Nichols yielded:

	Per cent.
Iron (Fe).....	91.99
Nickel (Ni).....	7.38
Cobalt (Co).....	.42
Copper (Cu).....	.01
Silicon (Si).....	.08
Phosphorus (P).....	.15
Sulphur (S).....	.06
	<hr/>
	100.09

*Reference.*—H. A. Ward, *Amer. Journ. Sci.*, vol. 19, 1905, p. 240.

**BISCHTUBE, PROVINCE OF TURGAI, RUSSIA. No. 329.**

Iron, Og. Weight, 1,290 grams; slice 14 by 24 cm., showing coarse lamellæ with inclusions of troilite and schreibersite. Weight of three original masses, 48.75 kilograms. Date of fall unknown; found in 1888. Described by E. A. Kislakowsky as consisting of:

	Per cent.
Schreibersite.....	3.85
Olivine.....	9.88
Anorthite.....	8.06
Nickel-iron.....	78.25
	<hr/>
	100.04

The nickel-iron contained:

	Per cent.
Iron (Fe).....	93.10
Nickel (Ni).....	4.82
Cobalt (Co).....	2.08
	<hr/>
	100.00

The percentage of cobalt is unusually high. Specific gravity as made on different samples from the mass, 6.36, 6.60, and 6.92. This iron was subsequently studied by Brezina, whose results differed greatly, so far as proportional amounts of the varying constituents are concerned. He found:

	Per cent.
Nickel-iron .....	93.97
Schreibersite .....	2.52
Carbon .....	.09
Chromite and silicate granules .....	.01
Undetermined residue .....	.41
	<hr/> 100.00

Omitting the undetermined residue and certain angular pieces separated in solution, he obtained for the iron:

	Per cent.
Iron (Fe) .....	91.52
Nickel (Ni) .....	7.12
Cobalt (Co) .....	.84
Phosphorus (P) .....	.39
Carbon (C) .....	.10
Copper (Cu) .....	.02
"Körner" (?) .....	.01
	<hr/> 100.00

*References.*—E. D. Kislakowsky, Ueber den Meteoriten von Turgaik. Bull. Soc. Imp. Nat. Moscow, No. 2, 1890, p. 187. Abstract in Neues Jahrb., vol. 1, 1892, p. 51. E. Cohen, Meteoreisen Studien, 5, Ann. k. k. Naturhist. Hofmus., vol. 12, Heft 1, 1897, p. 52.

**BISHOPVILLE, SUMTER COUNTY, SOUTH CAROLINA. No. 222.**

Stone, Chla. Weight, 102 grams; two fragments from the interior. Fell March 25, 1843. Original weight, 13 pounds (6 kilograms). This is a very interesting and somewhat unique stone belonging to Tschermak's group of chladnites, of which but four representatives are at present known. The stone was first described by Shepard in 1846 as consisting in large part of a light gray material regarded by him as a persilicate of magnesia to which he proposed to give the name *chladnite*, in honor of the chemist, Chladni. Subsequent researches (in 1864) by J. Lawrence Smith showed the mineral to be identical with enstatite. In addition to this, Shepard thought to discover two other new minerals, the one blue and the other yellow, to which he proposed to give, respectively, the names *iodolite* and *apatoid*. These have since been shown to be oxidation products of the nickeliferous iron, or pyrrhotite. The stone was described in 1851 by W. Sartorius von Waltershausen, who thought to show that the sili-

ceous portion of the stone was made up of 95.011 per cent chladnite and 4.985 per cent of labradorite. Rammelsberg, in 1863, declared, as a result of his examination, that the stone contained no feldspar. In 1883, the stone was studied by modern petrographic methods by M. E. Wadsworth, who agreed with Shepard in describing it as a grayish-white mass resembling albitic granite, with brown and black spots and with a structure essentially granitic. The mineral composition as given is as follows: Enstatite, augite, feldspar, olivine, pyrrhotite, and iron. No perfectly satisfactory chemical analysis of the stone as a whole has until recently been made, those of Shepard, Smith, Rose, and Rammelsberg being all on selected siliceous material. Recent results by J. E. Whitfield are as below:

	Per cent.
Silica ( $\text{SiO}_2$ )	57.034
Alumina ( $\text{Al}_2\text{O}_3$ )	1.708
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	1.406
Manganous oxide ( $\text{MnO}$ )	.189
Lime ( $\text{CaO}$ )	2.016
Magnesia ( $\text{MgO}$ )	33.506
Cobalt oxide ( $\text{CoO}$ )	Trace
Nickel oxide ( $\text{NiO}$ )	.538
Soda ( $\text{Na}_2\text{O}$ )	1.027
Potash ( $\text{K}_2\text{O}$ )	.089
Ignition ( $\text{H}_2\text{O}$ )	1.995
Iron ( $\text{Fe}$ )	.181
Nickel ( $\text{Ni}$ )	.089
Sulphur ( $\text{S}$ )	.297
	<hr/>
	100.023
Less O for S	.147
	<hr/>
	99.876

An amount of lime equivalent to 0.67 per cent calcium sulphide was liberated by boiling the finely pulverized stone for two hours in distilled water. Inspection of the stone in mass shows, in addition, occasional granules of an iron sulphide (troilite or pyrrhotite) which were evidently not included in the portion analyzed. No traces of barium, strontium, or zirconium could be detected. The amount of material utilized in the analysis was not as large as could have been desired.

*References.*—See Wülfing, p. 30. Also G. P. Merrill, *Mem. Nat. Acad. Sci.*, vol. 14, 1916, p. 7.

**BITBURG (ALBAACHER MÜHLE), RHEINISH PRUSSIA, GERMANY. Nos. 122, 445.**

Stony-iron, Pallasite. Irregular slag-like mass, weighing 22 grams, and polished and etched slice, some 35 by 35 by 20 mm., showing

original surface, weighing 86 grams. Found in 1802. Weight of original mass, over 1,600 kilograms. Analysis by Finkener yielded:

	Per cent.
Iron (Fe).....	85.04
Nickel (Ni).....	10.51
Cobalt (Co).....	1.70
Copper (Cu).....	.06
Carbonaceous matter.....	.09
Sulphur (S).....	1.89
Phosphorus (P).....	.20
	<hr/> 99.49

*Reference.*—See Wülfing, p. 31.

**BJELAJA ZERKOW, UKRAINE, KIEW, RUSSIA. No. 183.**

Stone, Ce or Cg. A 10-gram fragment from the interior of a mass which fell on January 16, 1796.

**BJELOKRYNITCHIE, VOLHYNIA, RUSSIA. No. 219.**

Stone, Cib. An 8-gram fragment from a stone which fell on January 1, 1887.

**SJURBÖLE, NEAR BORGA, IN SOUTHERN FINLAND. No. 224.**

Stone, Cca. Weight, 617 grams; fragment with crust. Fell on March 12, 1899, at about half past 10 p. m., local time. The fall was accompanied by the usual light and by thunder-like sounds. The light was seen over a large part of Finland; the direction of flight was from west to east, passing over the western part of the Finnish Sea at a height estimated as some 53 kilometers. The stone fell upon the frozen surface of a lake, the ice being some 40 mm. in thickness (a little more than an inch and a half), making a hole some 3.5 meters by 4.25 meters, with a very uneven outline. The water of the lake was 90 cm. (about 35½ inches) deep at this point, with a bottom consisting of mud composed largely of organic remains, and underlaid by clay, hard sand, and gravel, the stone burying itself in the clay, where it was found at a depth of 6 meters below the surface. The stone, when found, was broken in numerous pieces, large and small, estimated to weigh altogether 328 kilograms, of which the largest pieces weighed, respectively, 80.2, 21, 18, and 17 kilograms, the 80.2-kilogram piece being now in the museum of the Geological Survey of Finland. The stone is chondritic and very friable, of an ash gray color, with the usual crust. Composition:

	Per cent.
Magnetic material.....	5.84
Nonmagnetic material.....	94.16

## The magnetic portion yielded:

	Per cent.
Iron (Fe)-----	70.1 or 4.09 <sup>1</sup>
Nickel (Ni)-----	8.0 or .47 <sup>1</sup>
Cobalt (Co)-----	.3 or .018 <sup>1</sup>
Phosphorus (P)-----	.1 or .006 <sup>1</sup>
Ferrous sulphide (FeS)-----	1.9 or .110 <sup>1</sup>
Silicates-----	19.2 or 1.121 <sup>1</sup>
	<hr/>
	99.6      5.815

## The nonmagnetic portion yielded:

	Per cent.
Iron (Fe)-----	2.43
Nickel (Ni)-----	.27
Cobalt (Co)-----	.02
Sulphur (S)-----	2.06
Phosphorus (P)-----	.14
Silica (SiO <sub>2</sub> )-----	43.05
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	2.68
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> )-----	.62
Ferrous oxide (FeO)-----	19.06
Nickel oxide (NiO) }-----	.08
Cobalt oxide (CoO) }	
Manganous oxide (MnO)-----	.13
Lime (CaO)-----	1.91
Magnesia (MgO)-----	27.01
Potash (K <sub>2</sub> O)-----	.34
Soda (Na <sub>2</sub> O)-----	1.34
	<hr/>
	101.14
Less O for S-----	1.03
	<hr/>
	100.11

From these figures the bulk composition of the entire mass was calculated as follows:

	Per cent.
Iron (Fe)-----	6.38
Nickel (Ni)-----	.72
Cobalt (Co)-----	.04
Phosphorus (P)-----	.14
Ferrous sulphide (FeS)-----	5.44
Silica (SiO <sub>2</sub> )-----	41.06
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	2.55
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> )-----	.59
Ferrous oxide (FeO)-----	13.80
Nickel oxide (NiO)-----	.07
Manganous oxide (MnO)-----	.12
Lime (CaO)-----	1.82
Magnesia (MgO)-----	25.75
Potash (K <sub>2</sub> O)-----	.32
Soda (Na <sub>2</sub> O)-----	1.24
	<hr/>
	100.04

<sup>1</sup> Of the entire mass.

From this the mineral composition was calculated as:

	Per cent.
Nickel-iron .....	7.14
Troilite .....	5.44
Phosphor-nickel-iron .....	.90
Chromite .....	.87
Silicates .....	85.47
	<hr/> 99.82

The silicate material yielded, on analysis, results as follows:

	Per cent.
Silica ( $\text{SiO}_2$ ) .....	48.15
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	2.98
Ferrous oxide ( $\text{FeO}$ ) .....	14.75
Manganous oxide ( $\text{MnO}$ ) .....	.14
Lime ( $\text{CaO}$ ) .....	2.13
Magnesia ( $\text{MgO}$ ) .....	30.13
Potash ( $\text{K}_2\text{O}$ ) .....	.37
Soda ( $\text{Na}_2\text{O}$ ) .....	1.45
	<hr/> 100.10

the silicates being enstatite, augite, anorthite, olivine, maskelynite (?), and glass.

The structure is, as above noted, strongly chondritic, the chondrules being exceptionally variable in composition, the following forms being noted: (1) Anorthite chondrules; (2) olivine chondrules, both monosomatic and polysomatic; (3) glass chondrules with porphyritic olivine inclusion; (4) olivine-pyroxene chondrules; and (5) pyroxene chondrules. The structure, as a whole, is that of a fragmental rock, and it is so regarded by Messrs. W. Ramsay and L. H. Borgström, who have studied it.

*Reference.*—W. Ramsay and L. H. Borgström, *Bull. Comm. geol. Finlande*, No. 12, 1902.

BLUFF, FAYETTE COUNTY, TEXAS. Nos. 135, 240, 344.

Stone, Ckb. Three fragments of first find (1878), weighing 137 grams, 110 grams, and 6,363 grams, showing crust; one with black vein as figured in *American Journal of Science* (vol. 36, 1888, p. 118). One fragment found in 1901, weighing 3,136 grams, with one polished surface; other surfaces weathered. Date of fall unknown. Weight of mass found in 1878, 146,000 grams; chemical analyses by Whitfield yielded results as follows:

Constituents.	No. 1: Total mass.	No. 2: 5.67 per cent total metal.	No. 3: 33.3 per cent total in- soluble in HCl.	No. 4: 60.62 per cent total soluble in HCl.
Silica (SiO <sub>2</sub> ).....	37.70	.....	49.64	33.89
Iron (Fe).....	3.47	82.42	.....	.....
Ferrous oxide (FeO).....	23.82	.....	15.56	31.12
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	2.17	.....	4.12	1.34
Phosphoric acid (P <sub>2</sub> O <sub>5</sub> ).....	.25	.....	.....	.42
Lime (CaO).....	2.20	.....	4.93	1.00
Manganous oxide (MnO).....	.45	.....	.54	.43
Magnesia (MgO).....	25.94	.....	25.21	28.06
Nickel oxide (NiO).....	1.59	.....	Trace.	2.66
Nickel (Ni).....	.65	15.44	Trace.	.....
Cobalt oxide (CoO).....	.16	.....	Trace.	.27
Cobalt (Co).....	.09	2.14	.....	.....
Sulphur (S).....	1.30	.....	.....	2.18
Less O for S.....	99.79	100.00	100.00	101.09
	.65	.....	.....	1.09
	99.14	.....	.....	100.00
Specific gravity.....	3.510	.....	.....	.....

*Mineral composition.*—Mainly olivine and enstatite with 5.67 per cent metallic iron. Structure chondritic; compact; is traversed by narrow, irregular dark veins (see pl. 7, fig. 2), the origin of which is problematic. In mineral composition they do not differ essentially from the main mass of the stone. Color, dark greenish-gray on a fresh surface.

*Reference.*—J. E. Whitfield and G. P. Merrill, The Fayette County meteorite. Amer. Journ. Sci., vol. 36, 1888, pp. 113–119.

**BOHUMILITZ, PRACHIN, BOHEMIA, AUSTRIA. No. 446.**

Iron, Og. A slice 55 by 20 by 4 mm., weighing 103 grams, from a mass weighing some 57 kilograms, found in 1829. Several analyses have been made, but none can be considered satisfactory. Steinman gives iron, 94.06; nickel, 4.01; residue, 1.12; and sulphur, 0.81.

*Reference.*—Cohen and Weinschenk, Ann. k. k. Naturhist. Hofmus., vol. 6, 1891, p. 143.

**BORKUT, MARMAROS, HUNGARY. No. 189.**

Stone, Cc. Fragment from the interior, weighing 2 grams.

**BRACHIN, MINSK, RUSSIA. No. 124.**

Stony-iron, Pallasite. Fragment of the iron matrix from which all the stony matter has disappeared, weighing 14 grams; from a mass weighing some 100 kilograms, known as early as 1810.

**BRAUNAU, BOHEMIA, AUSTRIA, Nos. 49, 491.**

Iron, H. A fragment weighing 7.35 grams and a thin slice 25 by 30 by 2 mm., weighing 16 grams, from one of two masses weighing

17,082 grams and 23,628 grams, which fell July 14, 1847. This iron is of interest, being one of the very few which have been seen to fall, and, further, because of its hexahedral structure. The chemical analysis made by Fischer and Duflos is unsatisfactory.

*Reference.*—C. C. Beinert, *Der Meteorit von Braunau, Breslau, 1848.*

**BREMSEVÖRDE, GNARRENBURG, HANOVER, GERMANY. No. 144.**

Stone, Ccb. Fragment weighing 2 grams, from a mass weighing 7½ kilograms, which fell May 13, 1855.

**BRENNHAM, KIOWA COUNTY, KANSAS. Nos. 154, 161, 266, 271, 280, 287.**

Stony-iron, Pallasite. Weights 261, 326, 463, and 551 grams; also slice 31 by 25 cm., weighing 4.87 kilograms, and one complete individual weighing 17.27 kilograms. Date of fall unknown: found in 1885 when the prairie was first plowed. Over 20 individuals were found, weighing in the aggregate upward of 2,000 pounds, or about 909 kilograms, the largest individual weighing 466 pounds, or 211.8 kilograms. The relative proportions of olivine and iron are quite variable. (See pl. 11, fig. 1.) A polished surface shows large rounded blebs of greenish olivine imbedded in a groundmass of metallic iron. Occasional rounded masses of a bronze-colored troilite are evident, and there is a peculiar black lustrous border about the olivines which, as shown by Eakin's analyses, was evidently an iron-rich variety of the same mineral.

The chemical composition of the two chief constituents, as shown by analyses, is as follows:

Constituents.	Eakins.	Dodge.
<b>IRON.</b>		
	<i>Per cent.</i>	<i>Per cent.</i>
Iron (Fe).....	88.49	90.48
Nickel (Ni).....	10.35	8.69
Cobalt (Co).....	.57	.16
Copper (Cu).....	.03	Trace.
Phosphorus (P).....	.14	.27
Sulphur (S).....	.08	.06
Carbon (C).....	Trace.	Trace.
Silicon (Si).....	Trace.	.24
	99.66	99.79
<b>OLIVINE.</b>		
Silica (SiO <sub>2</sub> ).....	40.70	40.80
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	Trace.	.....
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> ).....	.18	.77
Ferrous oxide (FeO).....	10.79	10.51
Nickel oxide (NiO).....	.02	.....
Manganous oxide (MnO).....	.14	.....
Magnesia (MgO).....	48.02	47.18
	99.85	98.96

Specific gravity of the iron at 23.4° C., 7.93; of the olivine at 23.2°, 3.376, according to Eakins. The proportional mineral composition of the meteorites as a whole, as given by Winchell and Dodge, is as follows:

	Per cent.
Nickel-iron .....	74.42
Chromite .....	18.31
Troilite .....	4.76
Schreibersite .....	2.13
	<hr/> 99.62

Kunz thought to have detected scales of graphite, and speaks of the olivines leaving cavities highly polished, "showing even crystal face with a mirror-like luster." In the United States National Museum's specimens nothing of the kind exists, the cavities being smoothly rounded throughout.

No. 154, gift of George F. Kunz; No. 161, of Robert Hay.

*References.*—G. F. Kunz, On the group of meteorites recently discovered in Brenham Township, Kiowa County, Kansas. *Amer. Journ. Sci.*, vol. 40, 1890, pp. 312–318. N. H. Winchell and J. A. Dodge, The Brenham, Kiowa County, Kansas, meteorites. *Amer. Geologist*, vols. 5 and 6, 1890, pp. 309 and 370.

**BURLINGTON, OTSEGO COUNTY, NEW YORK. No. 22.**

Iron, Om. Fragment weighing 76.87 grams; one surface etched. Weight of original mass not known, but reported to have been from 100 to 200 pounds (45 to 90 kilograms). Date of fall unknown; plowed up in field and put in hands of a country blacksmith, who cut it up and made from portions articles for farmers' use. Analysis by B. Silliman, jr., showed:

	Per cent.
Metallic iron .....	92.291
Metallic nickel .....	8.146
	<hr/> 100.437

No other substances were detected. Specific gravity, 7.501.

*Reference.*—B. Silliman, jr., *Amer. Journ. Sci.*, vol. 46, 1843–44, p. 401.

**BUTLER, BATES COUNTY, MISSOURI. No. 96.**

Iron, Off. Section 7.5 by 5.5 by 1.1 cm. showing troilite nodules and weighing 270 grams. From a mass weighing 36 kilograms, first described in 1875. Analysis by J. L. Smith yielded:

	Per cent.
Iron (Fe) .....	89.12
Nickel (Ni) .....	10.02
Cobalt (Co) .....	.26
Copper (Cu) .....	.01
Phosphorus (P) .....	.12
	<hr/> 99.53



1



2

OXIDIZED CANON DIABLO IRON (1) AS FOUND, (2) SLICED TO SHOW METALLIC NUCLEUS.  
FOR DESCRIPTION SEE PAGE 51.



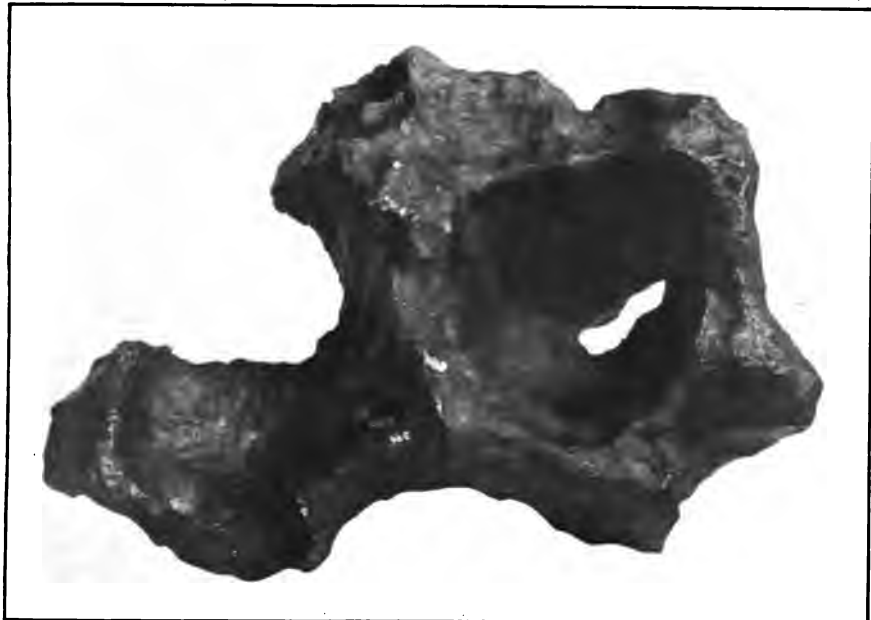


ETCHED SLICE OF CASAS GRANDES IRON.

FOR DESCRIPTION SEE PAGE 53.



44



1



2

(1) CANON DIABLO IRON, AND (2) COUCH, COAHUILA OR SANCHEZ ESTATE IRON.

FOR DESCRIPTIONS SEE PAGES 51 AND 141.



## CARLTON, HAMILTON COUNTY, TEXAS. No. 152.

Iron, Of. A 115-gram fragment from a mass weighing 81½ kilograms, found in 1887. (See also Tucson, p. 163.)

## CARTHAGE, SMITH COUNTY, TENNESSEE. No. 97.

Iron, Om. A 65-gram slice from a mass weighing 127 kilograms, found in 1840.

## CASAS GRANDES, CHIHUAHUA, MEXICO. No. 300.

Iron, Om. Large oval mass, 97 by 74 by 46 cm., weighing 1,317,920 grams, with cut surface 55 by 38 cm., showing Widmanstätten figures and troilite nodules; also three etched slices, 44 by 28 cm., 44 by 13 cm., and 42 by 25 cm., weighing altogether 17,573 grams; in introductory series, etched cube 5 cm. in diameter, weight 987 grams. (See pls. 15 and 16.) Found wrapped in coarse cloth and built into a brick tomb or altar. Original weight, 1,545,391 grams (3,407 pounds). No record of fall or early history. Composition as shown by J. E. Whitfield's analysis:

	Per cent.
Silicon (Si)-----	0.01
Iron (Fe)-----	90.470
Nickel (Ni)-----	7.742
Cobalt (Co)-----	.604
Copper (Cu)-----	.012
Carbon {combined-----	.145
{graphitic-----	.032
Phosphorus (P)-----	.168
Sulphur (S)-----	.029
Iron oxides-----	.794
	<hr/>
	100.004

*References.*—W. Tassin, Proc. U. S. Nat. Mus., vol. 25, 1902, pp. 69-74. Geo. P. Merrill, Amer. Journ. Sci., vol. 35, 1913, p. 514. W. A. Fletcher, On the Mexican meteorites. Min. Mag., vol. 9, 1890.

## CASTALIA, WASH COUNTY, NORTH CAROLINA. No. 101.

Stone, Cgb. Nineteen-gram fragment with black, papillated crust, from one of three fragments weighing 7,300 grams, which fell May 14, 1874.

## CERESETO, NEAR OTTIGLIO, PIEDMONT, ITALY. No. 245.

Stone, Cgb. Weight, 65 grams. Fragment with crust and slickensided fracture surfaces. Fell on the morning of July 17, 1840, at about half past seven. Flight was from east toward the west. Fall preceded by a sharp detonation. Three pieces were seen to fall, of which but one was found. Original weight, according to

Buchner, 5,000 grams, of which 4,361 grams are accounted for by Wülfing.

Composition: Olivine, pyroxene, and a feldspar, with a little iron and pyrrhotite.

Structure: Chondritic, brecciated, with slickensided surfaces.

Color: Ash gray.

CHANDAKAPUR, BERRAR, INDIA. No. 28.

Stone, Cib or Cgb. Four grams from a 5,076-gram mass which fell June 6, 1838.

CHANTONNAY, VENDÉE, FRANCE. No. 178.

Stone, Cgb. A 12-gram fragment of a black chondritic stone from a mass weighing some 10 kilograms, which fell on August 5, 1812.

CHARCAS, SAN LUIS POTOSI, MEXICO. No. 148.

Iron, Om. Pyramidal mass polished on four sides and weighing 67 grams, from a mass weighing originally some 778,069 grams, known as early as 1804, perhaps identical with Descubridora.

CHARSONVILLE, NEAR ORLEANS, LOIRET, FRANCE. No. 187.

Stone, Cga. Fragment with crust, weighing 54 grams, fell November 23, 1810.

CHATEAU-RENAUD, MONTARGIS, LOIRET, FRANCE. No. 312.

Stone, Cia. Weight, 360 grams. Irregular fragment with crust on one side; shows faults and slickensides. Fell at 1.30 p. m. June 12, 1841. Original weight, some 20 kilos; according to Buchner, 30 to 40 kilos. The flight was from the southwest to northeast, the fall being accompanied by the usual explosion. On striking the ground, was broken into fragments, the largest of which weighed 15 kilos. According to an analysis by Dufrénoy (1841), the stone consists of:

	Per cent.
Silica ( $\text{SiO}_2$ ) .....	38.13
Ferrous oxide ( $\text{FeO}$ ) .....	29.44
Magnesia ( $\text{MgO}$ ) .....	17.67
Manganese ( $\text{Mn}$ ) .....	Trace.
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	3.82
Lime ( $\text{CaO}$ ) .....	0.14
Iron ( $\text{Fe}$ ) .....	7.70
Nickel ( $\text{Ni}$ ) .....	1.55
Sulphur ( $\text{S}$ ) .....	.39
Potash ( $\text{K}_2\text{O}$ ) .....	.27
Soda ( $\text{Na}_2\text{O}$ ) .....	.86
	<hr/>
	99.97

Fifty-one per cent soluble in hydrochloric acid. From this the mineral composition was calculated:

By Dufrénoy:	Per cent.	By Rammelsberg:	Per cent.
Nickel-iron-----	9. 25	Nickel-iron-----	} 10. 00
Troilite -----	. 67	Troilite -----	
Olivine -----	51. 62	Olivine -----	52. 50
Albite -----	6. 31	Augite -----	21. 30
Hornblende -----	31. 86	Labradorite -----	16. 20
	<hr/> 99. 71		<hr/> 100. 00

Specific gravity, 8.56.

Structure compact, indistinctly chondritic.

*References.*—Dufrénoy, *Compt. Rend.*, vol. 13, 1841, p. 47. Rammelsberg, *Pogg. Ann.*, vol. 60, 1843, p. 136. O. Buchner, *Die Meteoriten*, 1863, p. 66.

CHEROKEE COUNTY, GEORGIA. Nos. 208, 249.

Iron, Om. Three pieces weighing 123, 189, and 423 grams. Cross sections and portion of end of mass showing Widmanstätten figures and grains of troilite. Date of fall unknown; found in 1894, 2½ miles east of Cherokee Mills and 5 miles southwest of Canton, in Cherokee County. Appearance of iron such as to lead to the supposition that it had lain in the soil for a long period. Analyses by H. N. Stokes yielded:

	Per cent.
Iron (Fe)-----	91. 96
Nickel (Ni) -----	6. 70
Cobalt (Co)-----	. 50
Copper (Cu) -----	. 03
Phosphorus (P)-----	. 01
Sulphur (S)-----	. 01
Silicon (Si)-----	Trace.
Carbon (C)-----	Trace.
	<hr/> 99. 21

Structure coarsely octahedral with broad kamacite lamellæ.

This iron is regarded by Wülfing as identical with that of Lost-town, Cherokee County, found in 1867, and described by Shepard in 1868. Howell does not agree to this.

*Reference.*—E. E. Howell, *Amer. Journ. Sci.*, vol. 50, 1895, p. 252.

CHICO MOUNTAIN, BREWSTER COUNTY, TEXAS. No. 512.

Iron, H. A 212-gram fragment from a mass of unknown weight found on the south side of Chico Mountain.

CHULAFINKEE, CLEBURNE COUNTY, ALABAMA. No. 61.

Iron, Om. Weight, 8.5 grams. From a mass weighing 14,750 grams found in 1873.

## CLEVELAND, EAST TENNESSEE. (See Iron.) No. 56.

Iron, Om. Weight, 221 grams. Slab, 11 by 5 mm., with one small troilite nodule. Found in 1860. Original weight, 150.5 kilograms. Composition, as given by F. A. Genth:

	Per cent.
Iron (Fe).....	89.93
Nickel (Ni).....	8.06
Copper (Cu).....	.06
Cobalt (Co).....	.56
Phosphorus (P).....	.66
	99.27

*Reference.*—F. A. Genth, Proc. Acad. Nat. Sci. Phila., 1886, p. 366.

## COAHUILA, MEXICO. (See also Sanchez Estate.) No. 64.

Iron, Hexahedrite. Weight, 3,510 grams. This practically complete mass is entered in previous catalogues as of unknown source, having been found in the collections without record. It is unquestionably the iron described by Prof. C. U. Shepard in the American Journal of Science<sup>1</sup> under the name of "A new meteoric iron of unknown locality in the Smithsonian Museum." Examination shows it to be a normal hexahedrite, and according to Shepard's analysis it has the following composition:

	Per cent.
Iron.....	92.923
Nickel.....	6.071
Cobalt.....	.539
Schreibersite.....	.562
	100.095

with traces of copper (and tin?).

Specific gravity, 7.589.

The physical and chemical characters all agree so closely with irons from Coahuila, Mexico, that it is thought to be unquestionably a member of that group, although the mass shows on the exterior surface numerous tendencies to exfoliate, which are lacking in others from this locality. It is, however, placed provisionally among the Coahuila irons.

## COLD BOKKEVELD, CAPE COLONY, SOUTH AFRICA. Nos. 5, 162.

Stone, K. Three fragments weighing 7 grams; fell October 13, 1838.

<sup>1</sup> Vol. 22, 1881.

**COOLFAX, RUTHERFORD COUNTY, NORTH CAROLINA. No. 151.**

Iron, O. Weight, 315 grams. One face etched. Original weight, 2,400 grams. Found, 1880. Nothing known regarding fall. Analysis by Eakins showed:

	Per cent.
Iron (Fe)-----	88.05
Nickel (Ni)-----	10.37
Cobalt (Co)-----	.68
Copper (Cu)-----	.04
Phosphorus (P)-----	.21
Sulphur (S)-----	.08
Silicon (Si)-----	.02
	<hr/> 99.45

Gift of S. W. Cramer.

*Reference.*—L. G. Eakins, Amer. Journ. Sci., vol. 39, 1890, p. 395.

**COLLESOPOLI, TERNI, ITALY. No. 493.**

Stone, Cc. Two grams of fragments from a stone weighing originally 4 to 5 kilograms, which fell February 3, 1890. The first analysis, by Trottarelli, yielded somewhat anomalous results, which were not borne out by Whitfield's later analysis given below:

	Per cent.
Silica (SiO <sub>2</sub> )-----	34.59
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	6.43
Ferrous oxide (FeO)-----	15.87
Magnesia (MgO)-----	21.17
Lime (CaO)-----	1.79
Potash (K <sub>2</sub> O)-----	.26
Soda (Na <sub>2</sub> O)-----	1.46
Iron (Fe)-----	17.04
Nickel (Ni)-----	1.49
Cobalt (Co)-----	.09
Manganese (Mn)-----	None.
Chromium (Cr)-----	None.
Sulphur (S)-----	None.
Ignition (H <sub>2</sub> O)-----	None.
	<hr/> 100.19

*References.*—Trottarelli, Gazz. Chim. Ital., vol. 20, 1890, p. 611. G. P. Merrill, Mem. Nat. Acad. Sci., vol. 14, 1916, p. 8.

**COON BUTTE, ARIZONA. No. 188.**

Stone, Cib. Complete cross section weighing 200 grams. Weight of original, 2,787 grams. Found 1905. Date of fall unknown. A gray, chondritic stone, presenting no unusual features. Analysis by J. W. Mallet of the metallic portion yielded:

	Per cent.
Iron (Fe)-----	88.81
Nickel (Ni)-----	10.72
Cobalt (Co)-----	.15
Tin (Sn)-----	.01
	<hr/> 99.69

with traces of copper, manganese, and carbon. The mineral composition as calculated by Mallet is:

	Per cent.
Enstatite .....	44.73
Olivine .....	33.43
Maskelynite .....	6.87
Nickel-iron .....	8.63
Iron rust .....	3.03
Schreibersite .....	.76
Pyrrhotite .....	2.14
Chromite .....	.08
	<hr/>
	99.72

Gift of D. M. Barringer.

*Reference.*—J. W. Mallet, Amer. Journ. Sci., vol. 21, 1906, p. 347.

COOPERTOWN, ROBERTSON COUNTY, TENNESSEE. No. 30.

Iron, Om. Section of mass 16 by 10 cm., etched, weighing 633 grams; from a mass weighing nearly 17 kilograms (37 pounds) found in 1860. Is of interest from the perfection of the Widmanstätten figures (see pl. 20). An analysis by J. L. Smith yielded:

	Per cent.
Iron (Fe) .....	89.59
Nickel (Ni) .....	9.12
Cobalt (Co) .....	.35
Phosphorus (P) .....	.04
Copper (Cu) .....	Trace.
	<hr/>
	99.10

Gift of D. Crockett.

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 31, 1861, p. 266.

COSBY'S CREEK, COCKE COUNTY, TENNESSEE. Nos. 70, 405.

Iron, Og. Thirty-four grams of fragments from an iron found in 1837. Analysis by Dr. J. Fahrenhorst yielded:

	Per cent.
Iron (Fe) .....	91.49
Nickel (Ni) .....	6.36
Cobalt (Co) .....	.72
Copper (Cu) .....	.02
Phosphorus (P) .....	.40
Sulphur (S) .....	.81
Carbon (C) .....	.20
	<hr/>
	100.00

The mineral composition is given as:

	Per cent.
Nickel-iron .....	94.95
Schreibersite .....	2.63
Troilite .....	2.22
Graphite, carbon, and silicates .....	.20
	<hr/>
	100.00

*References.*—G. Troost, Amer. Journ. Sci., vol. 38, 1840, pp. 250–254, and (for analyses) E. Cohen, *Meteoriten Studien*, 11 Ann. k. k. Naturhist. Hofmus., vol. 15, 1900, pp. 372–373.

**OOSTILLA PEAK, OLMARRON RANGE, TAOS, NEW MEXICO. No. 332.**

Iron, Om. Etched slice weighing 1,619 grams. Found 1881. Nothing known regarding fall. Original weight of mass 35 kilograms (78 pounds). Analysis by Eakins yielded:

	Per cent.
Iron (Fe)-----	91.65
Nickel (Ni)-----	7.71
Cobalt (Co)-----	.44
Phosphorus (P)-----	.10
Sulphur (S)-----	.28
	<hr/>
	100.16

*Reference.*—R. C. Hill, Proc. Colorado Sci. Soc., vol. 5, 1895, p. 121.

**CRAB ORCHARD MOUNTAINS, POWDER MILL CREEK, ROCKWOOD, TENNESSEE. Nos. 119, 346, 376.**

Stony-iron, Mesosiderite. Three fragments weighing 38, 943, and 1,010 grams. Found in 1887. Nothing known regarding fall. Weight of original three masses 43 kilograms. Shows metallic matrix containing grains of olivine and pyroxene. Structure quite irregular. Analysis by J. E. Whitfield yielded:

	Per cent.
Silica (SiO <sub>2</sub> )-----	41.92
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	9.27
Ferrous oxide (FeO)-----	22.94
Lime (CaO)-----	9.09
Magnesia (MgO)-----	8.76
Iron (Fe)-----	3.75
Nickel (Ni)-----	1.74
Chlorine (Cl)-----	.18
Phosphorus (P)-----	.65
Sulphur (S)-----	1.58
	<hr/>
	99.88

*Reference.*—J. E. Whitfield, Amer. Journ. Sci., vol. 34, 1887, p. 387.

**CRANBOURNE, VICTORIA, AUSTRALIA. Nos. 89, 121.**

Iron, Og. Two pieces weighing 15 and 71 grams, one with troilite nodules, from iron found in 1854.

**CROSS ROADS, BOYETT, WILSON COUNTY, NORTH CAROLINA. Nos. 163, 409.**

Stone, Cg. Twelve grams from a mass weighing 161 grams, which fell May 24, 1892.

## CROSS TIMBERS, RED RIVER, TEXAS. No. 95.

Iron, Om. Thirteen grams from a mass, the principal part of which, weighing  $740\frac{1}{2}$  kilograms, is now in the museum of Yale University. Found about 1808.

This is historically one of the most interesting of American meteoric irons. It was first made known to a white man (Capt. Anthony Glass) in 1808, by Indians, who seem to have regarded it with veneration, though apparently without recognizing its origin. In 1810 it was taken across the Brazos to the Red River and transported thence by boat to New Orleans, whence it was shipped to New York, where it passed into the possession of Col. George Gibbs and was by him deposited in trust in the museum of the New York Lyceum. After the death of Colonel Gibbs the iron was given to the museum of Yale University, Connecticut, where it still remains. Analyses by Shepard show it to consist of 90.02 of iron and 9.67 of nickel.

*References.*—Bruce's Min. Journ., vol. 1, 1814, pp. 127 and 218. Shepard, Amer. Journ. Sci., vol. 16, 1829, p. 217. See also vol. 27, 1835, p. 382.

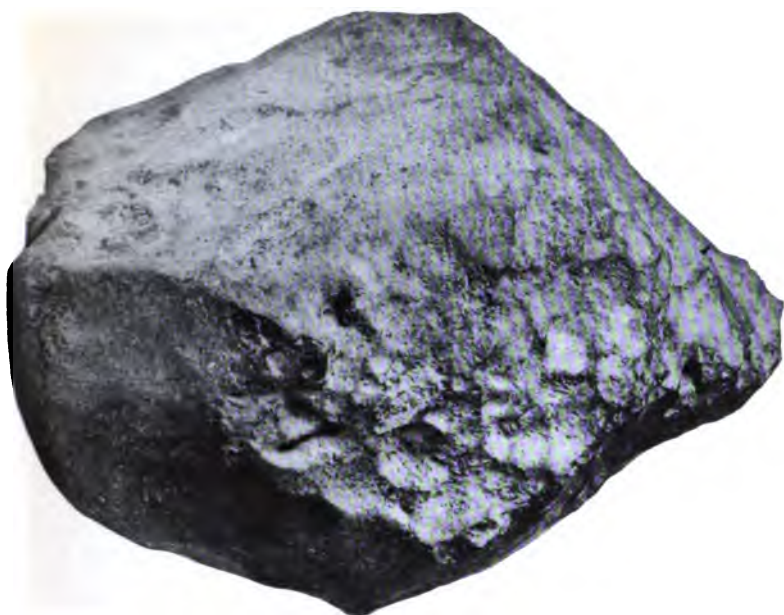
## GUERNAVACA, MEXICO. No. 447.

Iron, Of. Irregular slice 100 by 120 by 10 mm., weighing 757 grams.

## CULLISON, PRATT COUNTY, KANSAS. No. 430.

Stone, Cc. Slice weighing 277 grams; mass showing original surface, weighing 2,340 grams (pls. 18 and 19). Weight of original mass 10.10 kilograms. Found 1911. Nothing is known regarding fall. A very dense stone, nearly black, and the metallic points scarcely visible except on polished surface. Mineral composition, olivine, orthorhombic and monoclinic pyroxenes, and fragmentary plagioclase feldspars, together with metallic iron and iron sulphide. The slice shows a nodular mass some 10 by 17 mm., composed wholly of twinned pyroxenes with a few grains of troilite. The chemical and mineral composition, as determined by Whitfield, yielded results as below:

	Per cent.
Troilite (?) .....	6.00
Metallic iron .....	19.40
Silicate minerals .....	74.50
Schreibersite .....	.10
	<hr/>
	100.00



1

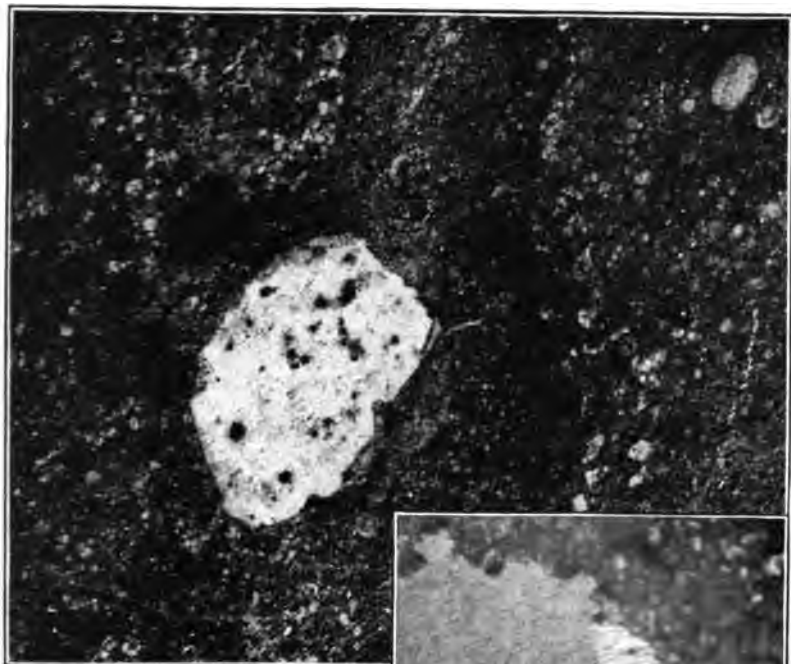


2

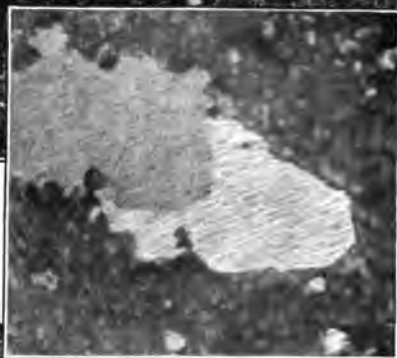
TWO VIEWS OF THE CULLISON STONE, AS FOUND.

FOR DESCRIPTIONS SEE PAGE 60.

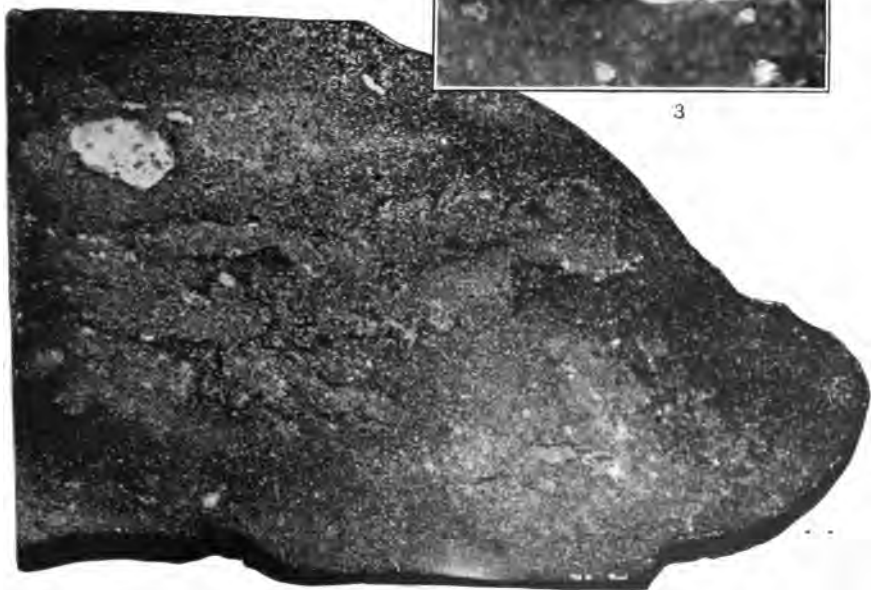
۴۹



1



3



2

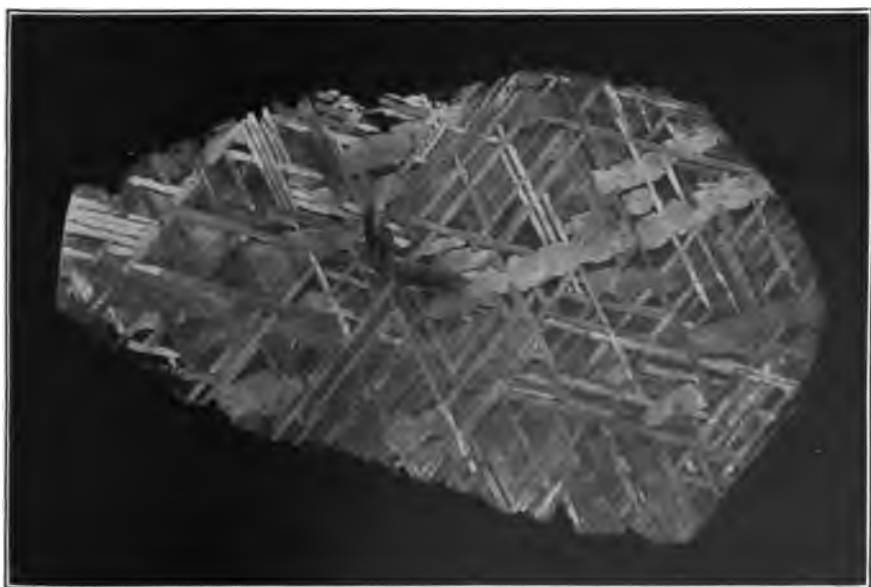
POLISHED SLICES OF THE CULLISON STONE.

FOR DESCRIPTION SEE PAGE 60.





1



2

ETCHED SLICES OF (1) KENDALL COUNTY IRON AND (2) OF COOPERTOWN IRON.

FOR DESCRIPTIONS SEE PAGES 58 AND 90.

111

**The metallic portions yielded:**

	Per cent.
Silicon (Si)-----	0.129
Sulphur (S)-----	Trace.
Phosphorus (P)-----	0.071
Nickel (Ni)-----	9.207
Cobalt (Co)-----	.507
Copper (Cu)-----	.040
Chromium (Cr)-----	.160
Carbon (C)-----	.088
Manganese (Mn)-----	.080
Iron (Fe)-----	89.700
	<hr/> 99.982

No traces found of molybdenum, tungsten, or vanadium.

**The silicate portion yielded:**

	Per cent.
Silica (SiO <sub>2</sub> )-----	47.36
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	5.67
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> )-----	.10
Ferrous oxide (FeO)-----	11.25
Lime (CaO)-----	.84
Magnesia (MgO)-----	31.72
Manganese protoxide (MnO)-----	.36
Soda (Na <sub>2</sub> O)-----	2.42
Potash (K <sub>2</sub> O)-----	.23
Titanic oxide (TiO <sub>2</sub> )-----	.00
	<hr/> 99.95

Combining the metallic and nonmetallic portions and recalculating, after making the very unsafe assumptions that the material called troilite is all the monosulphide, and that the schreibersite conforms to the formula (FeNi)<sub>3</sub>P, the following figures are obtained, representing the composition of the stone in mass or bulk:

	Per cent.
Silica (SiO <sub>2</sub> )-----	35.30
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	4.24
Ferric iron (Fe <sub>2</sub> O <sub>3</sub> )-----	.75
Ferrous iron (FeO)-----	8.38
Lime (CaO)-----	.62
Magnesia (MgO)-----	23.631
Manganous oxide (MnO)-----	.268
Soda (Na <sub>2</sub> O)-----	1.804
Potash (K <sub>2</sub> O)-----	.171
Sulphur (S)-----	2.184
Phosphorus (P)-----	.0138
Nickel (Ni)-----	1.80
Cobalt (Co)-----	.098
Copper (Cu)-----	.008
Chromium (Cr)-----	.029
Carbon (C)-----	.017
Manganese (Mn)-----	.015
Iron (Fe)-----	21.270
	<hr/> 100.5988

None of the rarer elements sometimes reported as occurring in meteorites were found, although very carefully looked for.

*Reference.*—G. P. Merrill, Publ. 1952, Proc. U. S. Nat. Mus., vol. 44, 1913, pp. 325–330.

**DALTON, WHITFIELD COUNTY, GEORGIA. Nos. 519, 520.**

Iron, Om. In Museum collection, two pieces weighing 35 and 80 grams from a 13-pound mass found in 1877. In Shepard collection 735.7 grams, and a larger, nearly complete individual weighing 50,340 grams (111 pounds) found in 1879. Nothing definite known of date of fall, and the two irons regarded as of doubtful identity.

An analysis of a slice from the 111-pound mass yielded J. E. Whitfield:

Iron (Fe) .....	81.853
Nickel (Ni) .....	7.434
Cobalt (Co) .....	.580
Copper (Cu) .....	.017
Platinum (Pt) .....	Trace.
Iridium (Ir) .....	.002
Silicon (Si) .....	.002
Manganese (Mn) .....	None.
Chromium (Cr) .....	None.
Sulphur (S) .....	.025
Phosphorus (P) .....	.081
Carbon (C) .....	.006
Schreibersite .....	10.00
	<hr/>
	100.000

An analysis of the same mass by Shepard yielded:

	Per cent.
Iron (Fe) .....	94.68
Nickel (Ni) .....	4.80
Cobalt (Co) .....	.34
	<hr/>
	99.80

*References.*—W. E. Hidden, Amer. Journ. Sci., vol. 21, 1881, p. 287.  
C. U. Shepard, Amer. Journ. Sci., vol. 26, 1883, p. 336.

**DANDAPUR, GORUCKPUR, INDIA. No. 408.**

Stone, Cia. Two grams from a stone which fell September 5, 1878.

**DEEP SPRINGS, ROCKINGHAM COUNTY, NORTH CAROLINA. No. 470.**

Iron, Db. Irregular slice some 10 by 4.5 cm. and showing part of original surface. Weight, 342 grams. Weight of original mass, 11,500 grams. Is stated to have fallen in 1846 and to have buried

itself 4 or 5 feet under the surface of the ground. Analysis by Venable yielded:

	Per cent.
Iron (Fe)-----	87.01
Nickel (Ni)-----	11.89
Cobalt (Co)-----	.79
Phosphorus (P)-----	.04
Silica (SiO <sub>2</sub> )-----	.53
Chlorine (Cl)-----	.39
	<hr/> 100.45

*Reference.*—F. P. Venable, Amer. Journ. Sci., vol. 40, 1890, p. 161.

DELEGATE, NEW SOUTH WALES. No. 484.

Iron, Om. Etched slice 6 by 7 cm., weighing 200 grams. Not yet described. Gift of Department of Mines, Sydney, New South Wales.

DESCUBRIDORA, SAN LUIS POTOSI, MEXICO. Nos. 78, 469.

Iron, Om. Rectangular fragment weighing 57.4 grams, with 3 etched faces; one face marked "Porte de aerolito del Estado de S. Luis Potosi caido en el anno de 1871"; another marked "A Ullis S. Grant." Received by the museum with the relics of President Grant. Also a triangular slice 34 by 25 cm. weighing 2,822 grams. These are from a mass weighing 576 kilograms now in the National Museum of Mexico. It is regarded by Fletcher as identical with the mass described by J. L. Smith under the name of "Venajas." Date of fall unknown. Said to have been found in 1780–1783. Chemical composition as determined by P. Murphy:

	Per cent.
Iron (Fe)-----	89.51
Nickel (Ni)-----	8.05
Cobalt (Co)-----	1.94
Sulphur (S)-----	.45
Chromium (Cr)-----	Trace.
	<hr/> 99.95

*References.*—L. Fletcher, On the Mexican meteorites, Min. Mag., vol. 9, 1890, p. 66. M. Barcena, On certain Mexican meteorites, Proc. Acad. Nat. Sci. Phila., 1876, p. 123.

DHURMSALA, KANGRA, PUNJAB, INDIA. Nos. 82, 498.

Stone, Ci. Fragments from interior weighing 32 and 43 grams. Fell July 14, 1860. Original weight approximately 145 kilograms, in form of several large masses. A gray, compact stone, to the naked eye indistinctly chondritic and showing no metallic points; faintly

rust spotted. Composition, according to analysis by C. T. Jackson, as follows:

	Per cent.
Silica ( $\text{SiO}_2$ ) with traces of tin oxide ( $\text{SnO}_2$ )	40.00
Magnesia ( $\text{MgO}$ )	28.60
Ferrous oxide ( $\text{FeO}$ )	27.70
Iron ( $\text{Fe}$ )	3.50
Nickel ( $\text{Ni}$ )	.80
Alumina ( $\text{Al}_2\text{O}_3$ )	.40
Chlorine ( $\text{Cl}$ )	.049
	<hr/> 99.049

This fall was remarkable from the fact that fragments picked up immediately after the fall were stated to have been so cold as to benumb the fingers, although but a moment before they had been glowing hot.

*References.*—C. T. Jackson, Proc. Boston Soc. Nat. Hist., vol. 8, 1861, p. 233; S. Houghton, Philos. Mag., vol. 32, 1866, p. 266.

**DJATI-PENGILON, DISTRICT OF NGAWI, JAVA. No. 114.**

Stone, Ck. Rectangular fragment with crust, weighing 469 grams. Weight of original mass, 166 kilograms. Fell March 19, 1884. Composition according to analysis of Verbeek and Retgers:

	Per cent.
Silica ( $\text{SiO}_2$ )	53.61
Alumina ( $\text{Al}_2\text{O}_3$ )	3.75
Ferrous oxide ( $\text{FeO}$ )	16.04
Manganous oxide ( $\text{MnO}$ )	Trace.
Lime ( $\text{CaO}$ )	3.00
Magnesia ( $\text{MgO}$ )	19.52
Potash ( $\text{K}_2\text{O}$ )	.07
Soda ( $\text{Na}_2\text{O}$ )	1.15
Chromate (?)	.24
	<hr/> 100.38

From this the mineral composition was calculated as:

	Per cent.
Nickel-iron	21.8
Iron sulphide	5.1
Olivine	33.4
Bronzite	39.0
Chromite	.1
	<hr/> 99.9

The nickel-iron consists of 88.68 iron, 10.78 nickel, and 0.54 cobalt; the iron sulphide consists of iron 63.64 and sulphur 36.36, which is the composition of troilite. This is claimed to be the first accurate determination of this form of the sulphide in a stony meteorite.

Gift of Government of Netherlands.

*Reference.*—Daubrée, *Compt. Rend.*, vol. 105, 1887, p. 203. Abstract in *Neues Jahrb. für Min.*, vol. 2, 1888, p. 35.

**DORES DOS CAMPOS, FORMOSOS NEAR UBERABA, MINAS GERAES, BRAZIL. No. 457.**

Stone, Cka. A fragment with crust, weighing 65 grams, from a fall aggregating 30 to 40 kilograms, which took place June 29, 1903. It is described by Hussak as a veined kugeln-chondrite consisting of bronzite, olivine, nickel-iron, troilite, and a little glass. Apparently has not been analyzed.

*Reference.*—E. Hussak, *Ann. k. k. Naturhist. Hofmus.*, vol. 19, 1904, p. 85.

**DORONINSK, DAURIA, IRKUTSK, SIBERIA. No. 181.**

Stone, Cgb. Fragment of 7.7 grams; fell April 6, 1805.

**DRAKE CREEK, NEAR NASHVILLE, DAVIDSON COUNTY, TENNESSEE.**

Stone, Cwa. 28-gram fragment with dull black papillated crust. Fell May 9, 1827.

**DURUMA, MOMBAS, WANIKALAND, EAST AFRICA. No. 216.**

Stone, Cia. Fragment weighing 1.5 grams. Fell March 6, 1853.

**EAGLE STATION, CARROLL COUNTY, KENTUCKY. Nos. 155, 275.**

Stony-iron, Pallasite (Rockiky group of Brezina). Two slices of 36 and 189 grams, respectively. Found in 1880. Date of fall unknown. Original weight, 36.5 kilograms. This meteorite belongs to an interesting group, of which but 3 representatives are known. They consist of more or less fragmental, often sharply angular olivines bound together by metallic nickel-iron and schreibersite. The mineral and chemical composition as given by Kunz is:

	Per cent.
Iron (Fe).....	71.73
Nickel (Ni).....	14.37
Cobalt (Co).....	.95
Phosphorus (P).....	.05
Olivine.....	11.12
Chromite.....	.90
	<hr/>
	99.12

The 36-gram slice the gift of George F. Kunz.

*Reference.*—G. F. Kunz, *Amer. Journ. Sci.*, vol. 33, 1887, p. 228.

**ELBOGEN, BOHEMIA, AUSTRIA. No. 309.**

Iron, Om. Weight, 71 grams. Prismatic piece some 60 by 16 by 11 mm. Date of fall unknown, perhaps 1400; preserved at the Rathhaus in Elbogen for centuries; first mentioned in 1785 and described as a meteorite in 1812. Original weight, 107 kilograms. Analysis by Berzelius yielded: Iron, 88.23; nickel, 8.51; insoluble, 2.211; cobalt, 0.762.

*Reference.*—See Wülfing, p. 111.

5692\*—Bull. 94—16—5

## EL CAPITAN, EL CAPITAN MOUNTAINS, NEW MEXICO. Nos. 109, 209, 245.

Iron, Om. Fragment showing cleavage, weighing 66 grams; slice 20 by 11 by 2 cm. weighing 753 grams, and end mass 20 by 10 by 5 cm. weighing 4 kilograms. Weight of original mass, 27,500 grams (about 61 pounds). Found in July, 1893, and supposed to have fallen in 1882. Structure is octahedral with broad bands of kamacite. Analysis by H. N. Stokes yielded:

	Per cent.
Iron (Fe) .....	90.51
Nickel (Ni) .....	8.40
Cobalt (Co) .....	.60
Copper (Cu) .....	.05
Silicon (Si) .....	Trace.
Phosphorus (P) .....	.24
Sulphur (S) .....	Trace.
	<hr/> 99.80

Sixty-six gram piece, gift of C. R. Biederman; 753-gram piece, gift of Edward E. Howell.

*Reference.*—E. E. Howell, Amer. Journ. Sci., vol. 50, 1895, p. 253.

## ELM CREEK, LYON COUNTY, KANSAS. No. 371.

Stone, CcO. Fragment weighing 1,120 grams. Found May, 1906. Date of fall unknown. A dark gray, compact stone showing numerous small points of metal on polished surface, and indistinct chondrules. Consists of the silicates olivine, and orthorhombic and monoclinic pyroxenes, and nickel-iron. Analysis by Whitfield yielded:

Metallic portion, 6.82; silicate portion, 93.18.

The metal yielded: Iron, 87.13; nickel, 11.30; cobalt, 1.42; manganese, 0.15.

The silicate portion yielded: Silica, 36.76; alumina, 3.10; ferric oxide, 13.23; ferrous oxide, 14.22; chromic oxide, 0.35; lime, 1.62; magnesia, 25.66; water, 5.10.

Recalculated, the following results are obtained to show the bulk or mass composition of the stone:

	Per cent.
Silica (SiO <sub>2</sub> ) .....	34.25
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	2.89
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> ) .....	12.32
Ferrous oxide (FeO) .....	13.25
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ) .....	.328
Lime (CaO) .....	1.509
Magnesia (MgO) .....	23.909
Iron (Fe) .....	5.94
Nickel (Ni) .....	.77
Cobalt (Co) .....	.09
Manganese (Mn) .....	.01
Volatile (H <sub>2</sub> O) (?) .....	4.75
	<hr/> 100.014

*References.*—K. Howard, Amer. Journ. Sci., vol. 23, 1907, p. 379.  
George P. Merrill, Mem. Nat. Acad. Sci., vol. 14, 1916, p. 10.

**EL NAKHLA EL BAHARIA, EGYPT. No. 426.**

Stone, A. Fell June 28, 1911. Two stones, one a nearly complete individual, with black, shining crust, weighing 117 grams, and one fragment weighing 52 grams. About 40 stones fell, weighing collectively nearly 10 kilograms, scattered over an area of some 4½ kilometers in diameter. Of peculiar interest, as this is the first recorded Egyptian fall. The stone is further unique in mineral and chemical composition, consisting mainly of green diopside and olivine. (See pl. 3, fig. 1.) The chemical composition as given by Prior is:

	Per cent.
Silica ( $\text{SiO}_2$ )	48.96
Titanic oxide ( $\text{TiO}_2$ )	.38
Alumina ( $\text{Al}_2\text{O}_3$ )	1.74
Chromic oxide ( $\text{Cr}_2\text{O}_3$ )	.33
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	1.29
Ferrous oxide ( $\text{FeO}$ )	19.63
Manganous oxide ( $\text{MnO}$ )	.09
Lime ( $\text{CaO}$ )	15.17
Magnesia ( $\text{MgO}$ )	12.01
Soda ( $\text{Na}_2\text{O}$ )	.41
Potash ( $\text{K}_2\text{O}$ )	.14
Sulphur (S)	.06
Water at 110°	.07
	<hr/> 100.28

Specific gravity, 3.47.

No barium, strontium, or zirconium detected.

Gift of Geological Survey of Egypt.

*Reference.*—G. T. Prior, Min. Mag., vol. 16, 1912, p. 274.

**EMMITSBURG, FREDERICK COUNTY, MARYLAND. Nos. 379, 414.**

Iron, Om. Two pieces, weighing 7 and 14 grams from a mass the original weight of which is not known, and of which only 177 grams appear to be now in existence. Found in 1854.

**ENSISHEIM, UPPER ALSACE, GERMANY. No. 506.**

Stone, Ckb. A 200-gram fragment, with crust, from a stone which fell on November 16, 1492, and is believed to be the oldest known meteoric stone extant. Fletcher refers to it in his "Introduction to the study of meteorites" (edition of 1908, p. 19) as follows:

The oldest undoubted sky-stone still preserved is that which was long suspended by a chain from the vault of the choir of the parish church of Ensisheim in Elsass, and is now kept in the Rathhaus of that town. The following is a translated extract from a document which was preserved in the church:

On the 16th of November, 1492, a singular miracle happened, for between 11 and 12 in the forenoon, with a loud crash of thunder and a prolonged noise

heard afar off, there fell in the town of Ensisheim a stone weighing 260 pounds. It was seen by a child to strike the ground in a field near the canton called Gisgaud, where it made a hole more than five feet deep. It was taken to the church as being a miraculous object. The noise was heard so distinctly at Lucerne, Villing, and many other places that in each of them it was thought that some houses had fallen. King Maximilian, who was then at Ensisheim, had the stone carried to the castle. After breaking off two pieces, one for the Duke Sigismund of Austria and the other for himself, he forbade further damage, and ordered the stone to be suspended in the parish church.

The stone is stated to have remained in the church until the French Revolution. Since then it has been frequently broken, and according to F. Crook, writing in 1868, but 40 or 50 kilograms remained. The fragments have been widely distributed and only a little over 70 kilograms are accounted for by Wülfing.

According to Crook's determinations, the stone consists of:

	Per cent.
Iron monosulphide.....	5.642
Metal .....	9.243
Chromite .....	.600
Silicates .....	84.079
	<hr/> 99.564

The mass or bulk composition as recalculated by Farrington from this analysis is:

	Per cent.
Silica ( $\text{SiO}_2$ ).....	36.65
Alumina ( $\text{Al}_2\text{O}_3$ ).....	2.31
Ferrous oxide ( $\text{FeO}$ ).....	34.19
Magnesia ( $\text{MgO}$ ).....	13.13
Lime ( $\text{CaO}$ ).....	1.78
Soda ( $\text{Na}_2\text{O}$ ).....	.38
Potash ( $\text{K}_2\text{O}$ ).....	.22
Iron ( $\text{Fe}$ ).....	8.00
Nickel ( $\text{Ni}$ ).....	1.23
Sulphur ( $\text{S}$ ).....	2.05
Phosphorus ( $\text{P}$ ).....	1.01
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....	.41
Manganous oxide ( $\text{MnO}$ ).....	.21
	<hr/> 101.57

*Reference.*—F. Crook, On the chemical constitution of the Ensisheim, Mauerkirchen, Shergotty, and Muddoor meteoric stones, Inaugural Dissertation, Göttingen, 1868, p. 21.

#### ERGHEO, SOMALILAND, AFRICA. No. 320.

Stone, Ckb. Fragment weighing 416 grams. Fell July, 1889. Total weight of fall, 20.375 kilograms. A compact, dark gray stone composed principally of olivine and a rhombic pyroxene with minor

quantities of troilite, nickel-iron, magnetite glass, and maskelynite. Chemical composition (analysis recalculated in part):

	Per cent.
Iron (Fe).....	0.57
Nickel and cobalt (Ni and Co).....	.17
Ferrous sulphide (FeS).....	9.48
Silica (SiO <sub>2</sub> ).....	42.55
Ferrous oxide (FeO).....	17.13
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	2.23
Lime (CaO).....	1.01
Magnesia (MgO).....	26.14
Potash and soda (K <sub>2</sub> O and Na <sub>2</sub> O).....	.12
	<hr/> 99.40

*Reference.*—E. Artini and G. Melzi, *Esplorazione Commerciale*, December, 1898.

**ESTACADO, CROSBY COUNTY, TEXAS. Nos. 372, 462.**

Stone, Cka. Polished slab 26 by 38 cm., weighing 5.45 kilograms, or 12 pounds, and slab weighing 476 grams. Weight of original mass, about 290 kilograms, or 638 pounds, and hence exceeding in size any known stony meteorites. Found in 1883 and supposed to have fallen the year previous. Composition as shown by Davison's analysis:

	Per cent.
Iron (Fe).....	14.68
Nickel (Ni).....	1.60
Cobalt (Co).....	.08
Copper (Cu).....	Trace.
Carbon (C) found, but not determined.	
Sulphur (S).....	1.37
Phosphorus (P).....	.15
Silica (SiO <sub>2</sub> ).....	35.82
Ferrous oxide (FeO).....	15.53
Magnesia (MgO).....	22.74
Lime (CaO).....	2.99
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	3.60
Soda (Na <sub>2</sub> O).....	2.07
Potash (K <sub>2</sub> O).....	.32
Titanic oxide (TiO <sub>2</sub> ) found, but not determined.	
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ) found, but not determined.	
Manganous oxide (MnO) found, but not determined.	
	<hr/> 100.95
Less O for S.....	.68
	<hr/> 100.27

The mineral composition was found to be: Metallic, 16.41; silicates, 83.59, being mainly olivine and enstatite. Chromite and pyrrhotite are also present in small quantities.

The 12-pound piece gift of Mrs. Coonley-Ward.

*Reference.*—Howard and Davison, Amer. Journ. Sci., vol. 22, 1906, p. 55.

ESTHERVILLE, EMMET COUNTY, IOWA. Nos. 12-15, 38, 425.

Stony-iron, M. Forty-five nodular pieces weighing all together 478 grams; one of these, No. 13, weighing 82 grams, the original specimen examined by Dr. J. L. Smith. Total weight of known material, 337 kilograms. Fall occurred about 5 p. m. on May 10, 1879, under a clear sky. In some places the meteorite was plainly visible, looking like a ball of fire, with a long train of vapor or cloud of fire behind it. One observer saw it at a distance of 100 miles from where it fell. The sounds produced were described as terrible and "indescribable," as scaring cattle, and terrifying people over an area many miles in diameter. At first these sounds were louder than that of the largest artillery. These were followed by a rumbling noise, as of a train of cars crossing a bridge. The concussion, when it struck the ground, was sensible to many persons, and it is reported that the soil was thrown into the air at the edge of a ravine where the largest masses struck. There were distinctly two explosions—the first at a considerable height, whereby several large fragments were projected to different points over an area of 4 square miles. The second explosion occurred just before reaching the ground and accounts for the numerous small fragments. The largest fragment, weighing 437 pounds, embedded itself 8 feet in a stiff blue clay. In all 744 pounds, or 337 kilograms. The irregular structure of this meteorite makes any attempt at mass analyses unsatisfactory. J. L. Smith found its mineral composition to be olivine, pyroxene, nickel-iron, troilite and chromite, and an undetermined silicate.

Nos. 12 to 15 gift of Mr. Charles P. Birge; No. 425 from the G. F. Barker estate.

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 19, 1880, p. 459.

FARMINGTON, WASHINGTON COUNTY, KANSAS. No. 382.

Stone, Csa. Fragment, with crust on one side. Weight, 204 grams. A dark gray compact stone which fell June 25, 1890; two stones weighing, respectively, 4 and 80 kilograms, the larger of which penetrated the hard shaly earth to a depth of nearly 4 feet. An analysis by L. G. Eakins shows the stone to consist of:

	Per cent.
Nickel-iron .....	7.7
Troilite .....	5.0
Silicates soluble in HCl (olivine) .....	48.0
Silicates insoluble in HCl (mostly pyroxene) .....	41.5
	<hr/> 100.2

*Reference.*—Kunz and Weinschenk, Amer. Journ. Sci., vol. 43, 1892, p. 65.





1



2

(1) FELIX STONE; (2) THE THIRD LARGEST STONE OF THE FISHER FALL

FOR DESCRIPTIONS SEE PAGES 71 AND 72.

## FELIX, PERRY COUNTY, ALABAMA. No. 235.

Stone, Cc. Weight, 1,708 grams. Principal mass with thin black crust on all sides but one. (See plate 21.) Fell about 11.30 a. m. on May 15, 1900. Weight of original mass, so far as known, 2,049 grams. Flight was from east toward the west. First explosion a "very loud report, followed by two lesser ones, the appearance being compared to that of a big pan of red-hot iron being struck with a hammer, causing many sparks to fly-in all directions." While in the air the stone broke into three pieces, of which but one, the largest, was found. Composition:

	Per cent.	
Iron (Fe) -----	2.59	} Metallic portion.
Nickel (Ni) -----	.36	
Cobalt (Co) -----	.08	
Copper (Cu) -----	.01	
Silica (SiO <sub>2</sub> ) -----	33.57	} Stony portion.
Alumina (Al <sub>2</sub> O <sub>3</sub> ) -----	3.24	
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ) -----	.80	
Ferrous oxide (FeO) -----	26.22	
Ferrous sulphide (FeS) -----	4.76	
Manganous oxide (MnO) -----	.68	
Nickel and cobalt oxides (NiO and CoO) -----	1.01	
Lime (CaO) -----	5.45	
Magnesia (MgO) -----	19.74	
Potash (K <sub>2</sub> O) -----	.14	
Soda (Na <sub>2</sub> O) -----	.62	
Carbon (C) (graphite) -----	.36	
Ignition (H <sub>2</sub> O) at 110° -----	.16	
	<hr/>	
	99.79	

## Mineral composition:

	Per cent.
Metal -----	3.04
Troilite -----	4.76
Chromite -----	1.17
Graphite -----	.36
Soluble silicate (olivine in part) -----	72.60
Insoluble silicate (enstatite and augite in part) -----	18.07
	<hr/>
	100.00

Specific gravity, 3.78.

Structure chondritic, tufaceous; color, dark, smoky gray.

*Reference.*—George P. Merrill, On a new stony meteorite which fell near Felix, Perry County, Alabama, May 15, 1900. Proc. U. S. Nat. Mus., vol. 24, 1901, pp. 193–198.

## FINMARKEN, NORWAY. No. 329.

Stony-iron, Pallasite. Slice 10 by 17 cm., weighing 595 grams. Found in 1902. Date of fall unknown. Weight of original mass, 77.5 kilograms, or 170½ pounds.

*Reference.*—E. Cohen, Mitth. naturwiss. Ver. Neu-Vorpommern u. Rügen, vol. 35, 1903.

**FISHER, POLK COUNTY, MINNESOTA. No. 212.**

Stone, Cia. Nearly complete individual weighing 1.30 kilograms. Fell April 9, 1894 (pl. 21, fig. 2). Four stones known to have fallen, the largest being broken up and scattered. The second largest weighed  $9\frac{1}{4}$  pounds and is in the museum of the University of Minnesota. A compact, light gray stone, thickly spotted with metallic points and light gray and white chondrules. Chemical analysis by J. E. Whitfield, yielded:

	Per cent.
Metallic constituents.....	11.44
Silicate constituents.....	88.56
The silicate portion yielded:	
	Per cent.
Silica ( $\text{SiO}_2$ ).....	43.70
Alumina ( $\text{Al}_2\text{O}_3$ ).....	4.96
Ferrous oxide ( $\text{FeO}$ ).....	18.27
Manganous oxide ( $\text{MnO}$ ).....	.38
Nickel oxide ( $\text{NiO}$ ).....	.23
Lime ( $\text{CaO}$ ).....	2.19
Magnesia ( $\text{MgO}$ ).....	29.38
Chromite ( $\text{FeOCr}_2\text{O}_3$ ).....	.80
	<hr/> 99.91

The chromium present is tabulated as chromite, as it occurs as such in the stone.

The metallic portion freed from the last trace of siliceous matter contained:

	Per cent.
Iron (Fe).....	85.00
Nickel (Ni).....	14.15
Cobalt (Co).....	.74
Copper (Cu).....	Trace.
	<hr/> 99.89

On recalculating, these figures give the bulk or mass composition of the stone as follows:

	Per cent.
Silica ( $\text{SiO}_2$ ).....	38.699
Alumina ( $\text{Al}_2\text{O}_3$ ).....	4.240
Ferrous oxide ( $\text{FeO}$ ).....	16.179
Manganous oxide ( $\text{MnO}$ ).....	.336
Nickel oxide ( $\text{NiO}$ ).....	.200
Lime ( $\text{CaO}$ ).....	1.939
Magnesia ( $\text{MgO}$ ).....	29.018
Chromite ( $\text{FeOCr}_2\text{O}_3$ ).....	.708
Iron (Fe).....	9.724
Nickel (Ni).....	1.608
Cobalt (Co).....	.084
	<hr/> 99.735

with traces of sulphur and soda but none of barium, strontium, zirconium, or potassium.

*Reference.*—George P. Merrill, Proc. U. S. Nat. Mus., vol. 48, 1915, pp. 503–506.

**FLOYD MOUNTAIN, INDIAN VALLEY, VIRGINIA. No. 323.**

Iron, Hb. Etched slice 15 by 9 cm. Weight 560 grams. Found 1887. Date of fall unknown. Weight of original mass 14.2 kilograms, or 31½ pounds. A coarsely granular, brecciated hexahedrite, of which but 8 representatives have thus far been described. Composition as determined by L. C. Eakins:

	Per cent.
Iron (Fe)-----	93.59
Nickel (Ni)-----	5.56
Cobalt (Co)-----	.53
Copper (Cu)-----	Trace.
Phosphorus (P)-----	.27
Sulphur (S)-----	.01
Silicon (Si)-----	Trace.
	<hr/> 99.96

*Reference.*—Kunz and Weinschenk, Amer. Journ. Sci., vol. 43, 1892, p. 424.

**FOREST CITY, WINNEBAGO COUNTY, IOWA. Nos. 157, 158, 166, 167, 338.**

Stone, Ccb. Nine fragments and more or less complete individuals weighing 35, 42, 45, 83, 150, 248, 257, 297, and 1,074 grams. Fell May 2, 1890. The shower comprised five large stones weighing, respectively, 4, 4, 10, 66, and 80 pounds, and over 500 small stones weighing from a fraction of 1 to 20 ounces. Total weight, so far as known, 122 kilograms, 37 grams. Chemical analysis by L. C. Eakins yielded:

	Per cent.
Iron (Fe)-----	18.076
Nickel (Ni)-----	1.192
Cobalt (Co)-----	.127
Ferrous sulphide (FeS)-----	6.189
Silica (SiO <sub>2</sub> )-----	35.622
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	2.082
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> )-----	.096
Ferrous oxide (FeO)-----	10.248
Lime (CaO)-----	1.415
Magnesia (MgO)-----	23.938
Potash (K <sub>2</sub> O)-----	.056
Soda (Na <sub>2</sub> O)-----	.812
	<hr/> 99.853

The 45-gram piece, gift of J. P. Dolliver; the 83-gram, of George F. Kunz.

*Reference.*—G. F. Kunz, Amer. Journ. Sci., vol. 40, 1890, pp. 312-323.

**FORT DUNCAN, MAVERICK COUNTY, TEXAS. No. 443.**

Iron, H. A 258-gram fragment, some 65 by 100 by 18 mm., by some supposed to be identical with the Coahuila.

**FRANCEVILLE, EL PASO COUNTY, COLORADO. No. 323.**

Iron, Om. Etched slab, 18 by 10 cm., weighing 300 grams. Found in 1890. Date of fall unknown. Weight of original mass, 18.3 kilograms, or 41 pounds, 6½ ounces. Partial analysis by Davison yielded:

Kamacite	} Fe, 91.92; Ni, 8.13.
Taenite	
Schreibersite,	0.837.
Platinum,	traces.

*Reference.*—H. L. Preston, Journ. Geol., vol. 10, 1902, p. 852.

**FUKUTOMI, KINEJIMA, HIZEN, JAPAN. No. 113.**

Stone, Cga. Weight, 9.7 grams. Fell on March 19, 1882, at 1 p. m. Original weight, 7,680 grams. Gift of Educational Museum of Tokyo, Japan.

**GARGANTILLO (TOMATLAN) JALISCO, MEXICO. No. 40.**

Stone, Cc. Fragment weighing 4 grams, from the interior. Exact date of fall not known—either August or September, 1879.

**GIBEON (MUKEROP), GREAT NAMAQUALAND, SOUTHWEST AFRICA. No. 330.**

Iron, Off. Etched slab 25 by 70 cm., weighing 14.32 kilograms, or 31.5 pounds (see pl. 22). From a mass weighing 178 kilograms, found in 1899. The cross section, as etched, shows three zones of crystallization, as though three differently oriented masses had been welded together. A chemical analysis by O. Hillebrand yielded:

	Per cent.
Iron (Fe)-----	90.96
Nickel (Ni)-----	8.19
Cobalt (Co)-----	.46
Copper (Cu)-----	.04
Carbon (C)-----	.02
Chromium (Cr)-----	.02
Chlorine (Cl)-----	.01
Sulphur (S)-----	Trace.
Phosphorus (P)-----	0.18
Residue-----	.01
	<hr/> 99.89

*Reference.*—A. Brezina and E. Cohen, Jahr. Ver. Vaterl. Naturk. in Württemberg, vol. 58, 1902, p. 292.



**ETCHED SLICE OF GIBEON (MUKEROP) IRON.**

FOR DESCRIPTION SEE PAGE 74.



44

## GILGOIN STATION NO. 1, NEAR BREWARRINA, NEW SOUTH WALES. No. 288.

Stone, Ck. Weight, 290 grams. Fragment with polished surface and crust. Date of fall unknown. Found 1889. Weight of original mass about  $30\frac{1}{2}$  kilograms, or  $67\frac{1}{2}$  pounds. A compact chondritic stone composed essentially of olivines and enstatites with metallic iron and iron sulphide. The most striking feature is the abundance of small, wavy, nearly parallel fracture lines, which may have been produced by impact with the earth, or by shearing stresses in the mass itself. Analysis by A. Liversidge yielded:

Magnetic portion:	Per cent.
Insoluble in HCl.....	1.5074
Iron, metallic.....	82.4551
Nickel } .....	8.3451
Cobalt } .....	
Sulphur.....	Trace.
Phosphorus .....	None.
Oxygen and undetermined.....	7.6924

100.00

Nonmagnetic portion (dried at  $105^{\circ}$  = 0.349 per cent of moisture):

	Per cent.
Silica ( $\text{SiO}_2$ ).....	42.690
Ferrous oxide ( $\text{FeO}$ ).....	12.665
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ).....	6.698
Alumina ( $\text{Al}_2\text{O}_3$ ).....	4.980
Nickel (Ni).....	.280
Cobalt (Co).....	None.
Manganese (Mn).....	Traces.
Lime ( $\text{CaO}$ ).....	17.530
Magnesia ( $\text{MgO}$ ).....	12.661
Soda ( $\text{Na}_2\text{O}$ ).....	.744
Potash ( $\text{K}_2\text{O}$ ).....	.104
Sulphur (S).....	2.535
Chlorine (Cl).....	None.
Phosphorus (P).....	.135

101.022

Less oxygen equivalent to sulphur and phosphorus .....

1.267

99.755

*Reference.*—A. Liversidge, Journ. Proc. Roy. Soc. N. S. Wales, vol. 36, 1903, p. 352.

## GILGOIN STATION NO. 2, NEAR BREWARRINA, NEW SOUTH WALES. No. 465.

Stone, Ck. Mass with three surfaces sawn and one broken. Weight, 1,299 grams. Found February 8, 1893, about 2 miles south of Gilgoi No. 1, and regarded as part of the same fall. Weight of original mass  $33\frac{1}{2}$  kilograms, or  $74\frac{1}{2}$  pounds.

*Reference.*—A. Liversidge, Journ. Proc. Roy. Soc. N. S. Wales, vol. 36, 1903, p. 354.

GILGOIN STATION NO. 7, NEAR BREWARRIMA, NEW SOUTH WALES. No. 509.

Stone, Ck. Rough, oxidized fragment. Weight, 155 grams. Gift of J. C. H. Mingaye.

GIRGENTI, SICILY. No. 378.

Stone, Cwa. Fragment with crust, weighing 99 grams. Fell February 10, 1853. Weight of original mass some 3 or 4 kilograms. History very incomplete. Analysis yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	39.81
Alumina ( $\text{Al}_2\text{O}_3$ )	1.44
Ferrous oxide ( $\text{FeO}$ )	16.47
Magnesia ( $\text{MgO}$ )	24.01
Lime ( $\text{CaO}$ )	1.696
Soda ( $\text{Na}_2\text{O}$ )	1.375
Iron ( $\text{Fe}$ )	10.381
Nickel ( $\text{Ni}$ )	1.054
Sulphur ( $\text{S}$ )	2.054
	<hr/>
	98.89
Chromite	1.10
	<hr/>
	99.99

*Reference.*—G. Vom Rath, Pogg. Ann., vol. 138, 1869, p. 541.

GLORIETA MOUNTAIN, SANTA FE COUNTY, NEW MEXICO. No. 47.

Iron, Om. Weight, 380 grams. Polished slab 13.3 by 6.6 cm. Date of fall unknown. Found August 9, 1884. The original find consisted of three masses weighing, respectively, 67.35 kilograms (148½ pounds), 52.38 kilograms (115 pounds), and 24.263 kilograms (53½ pounds). Later four smaller pieces were found, of which one has disappeared. The three remaining weighed 337 kilograms (744 pounds). The fragments were regarded by Kunz as originally portions of one mass, which, however, was disrupted on striking and not in mid-air. The composition of the iron, as a whole, as determined by Eakins, is as follows:

	Per cent.
Iron ( $\text{Fe}$ )	88.76
Nickel ( $\text{Ni}$ )	9.86
Cobalt ( $\text{Co}$ )	.51
Copper ( $\text{Cu}$ )	.034
Zinc ( $\text{Zn}$ )	.030
Chromium ( $\text{Cr}$ )	Trace
Manganese ( $\text{Mn}$ )	Trace
Carbon ( $\text{C}$ )	0.410
Phosphorus ( $\text{P}$ )	.182
Sulphur ( $\text{S}$ )	.012
Silicon ( $\text{Si}$ )	.044
	<hr/>
	99.842

Subsequent determinations by Whitfield failed to show any traces of zinc.

Cohen and Weinschenk examined this iron and found it to consist of:

	Per cent.
Nickel-iron .....	83.30
Taenite .....	4.35
Schreibersite .....	7.87
Kamacite .....	4.22
"Rost" .....	.18
Carbonaceous matter .....	.08
	<hr/> 100.00

*References.*—George F. Kunz, The meteorites from Glorieta Mountain, Santa Fe County, New Mexico. Ann. New York Acad. Sci., vol. 3, 1885, pp. 329–334. E. Cohen and E. Weinschenk, Meteoreisen Studien, 13, Ann. k. k. Naturhist. Hofmus., vol. 6, 1891, p. 155.

**GRAND RAPIDS (WALKER TOWNSHIP), KENT COUNTY, MICHIGAN. No. 31.**

Iron, Of. Etched slice 16 by 11 cm., weighing 1,205 grams, and one 13 by 11 cm., weighing 966 grams. Found in 1883. Nothing known regarding fall. Analysis by R. B. Riggs yielded:

	Per cent.
Iron (Fe) .....	88.71
Nickel (Ni) .....	10.69
Copper (Cu) .....	.07
Magnesium (Mg) .....	.02
Phosphorus (P) .....	.26
Sulphur (S) .....	.03
Carbon (C) (combined) .....	.06
Graphite .....	.07
	<hr/> 99.01

Gift of J. G. Pulcher.

*References.*—R. B. Riggs, Amer. Journ. Sci., vol. 30, 1885, p. 312; Bull. U. S. Geol. Surv. 42, 1887, p. 94.

**GREENBRIER COUNTY, 3 MILES NORTH OF WHITE SULPHUR SPRINGS, WEST VIRGINIA. No. 118.**

Iron, Og. Eleven grams from a mass weighing some 11 pounds, found in 1880.

**GROSNAYA (MIKENSKOI), RIVER TEREK, CAUCASUS, RUSSIA. No. 138.**

Stone, Ca. Weight,  $4\frac{1}{2}$  grams. Fell June 28, 1861.

## GROSSLIEBENTHAL, NEAR ODESSA, UKRAINE, RUSSIA. No. 511.

Stone, Cwa. Fragment from interior weighing 10 grams, from a mass weighing 8,048 grams which fell on the 19th of November, 1881. The composition is given as follows:

	Per cent.
Hygroscopic water .....	.10
Silica ( $\text{SiO}_2$ ) .....	39.57
Magnesia ( $\text{MgO}$ ) .....	22.97
Lime ( $\text{CaO}$ ) .....	2.28
Ferrous oxide ( $\text{FeO}$ ) .....	13.44
Manganous oxide ( $\text{MnO}$ ) .....	.53
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	2.45
Soda ( $\text{Na}_2\text{O}$ ) .....	1.30
Potash ( $\text{K}_2\text{O}$ ) .....	.45
Iron sulphide ( $\text{Fe}_7\text{S}_8$ ) .....	6.73
Nickel-iron ( $\text{FeNi}$ ) .....	8.16
Chrome iron ( $\text{FeCr}_2\text{O}_4$ ) .....	1.30
Phosphorus (P) .....	.02
Phosphoric acid ( $\text{P}_2\text{O}_5$ ) .....	.21
Chlorine (Cl) .....	.04
Chromium (Cr) .....	Traces.
	<hr/>
	99.35

*Reference.*—P. Melikoff and C. Schwalbe, Ber. Deut. Chem. Ges., vol. 26, 1893, p. 234.

## HACHIMAN, MINO PROVINCE, JAPAN. No. 440.

Stone. Three fragments weighing 21 grams.

## HAINHOLZ, MINDEN, WESTPHALIA, GERMANY. Nos. 186, 507.

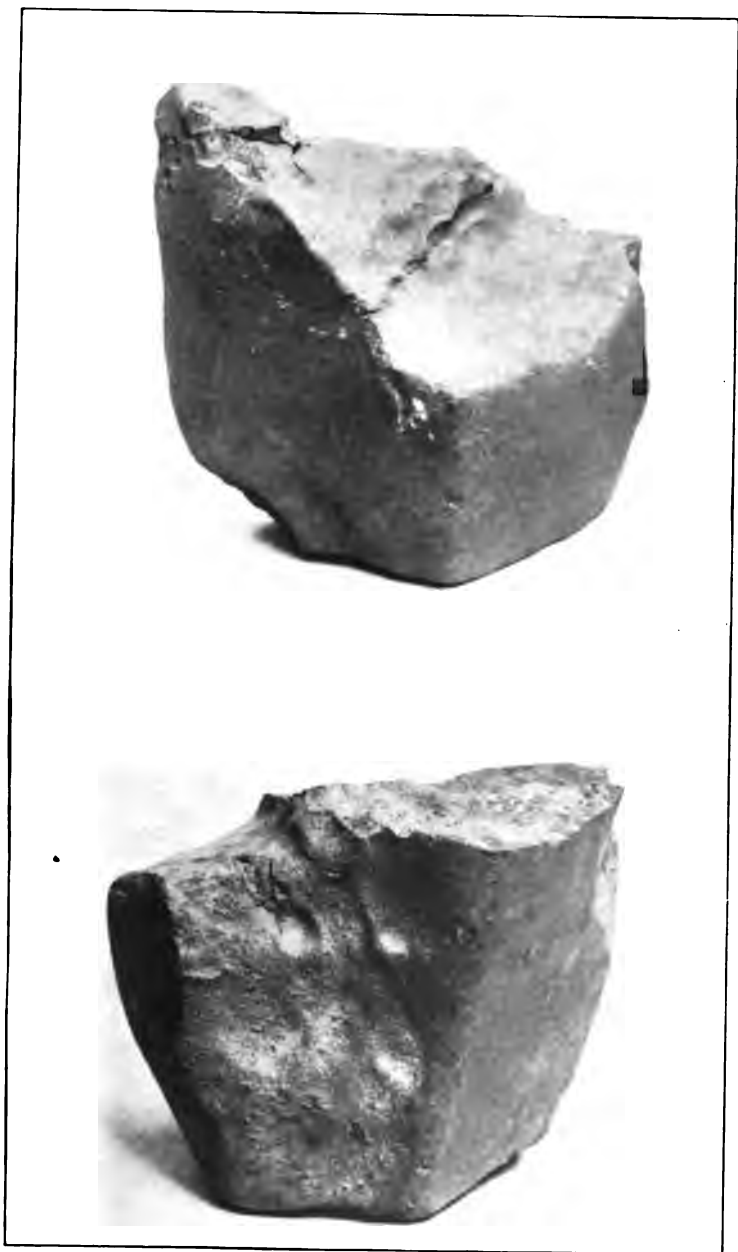
Stony-iron, Mesosiderite. Two fragments weighing 8 and 17 grams, from a mass weighing 16½ kilograms, found in 1856.

## HAMMOND TOWNSHIP, ST. CROIX COUNTY, WISCONSIN. No. 471.

Iron, Or. Weight, 298 grams. Irregular slice 17.5 by 6.5 cm. Etched and showing large troilite nodule, with gash-like veins of schreibersite. Weight of original mass, 24 kilograms, or about 53 pounds. Found in 1884. Chemical analysis yielded:

	Per cent.
Iron (Fe) .....	89.78
Nickel (Ni) .....	7.65
Cobalt (Co) .....	1.33
Phosphorus (P) .....	.51
Silica ( $\text{SiO}_2$ ) .....	.56
Carbon (C), copper (Cu), and tin (Sn) .....	Traces.
	<hr/>
	99.83

*Reference.*—Davenport Fisher, Amer. Journ. Sci., vol. 34, 1887, p. 381.

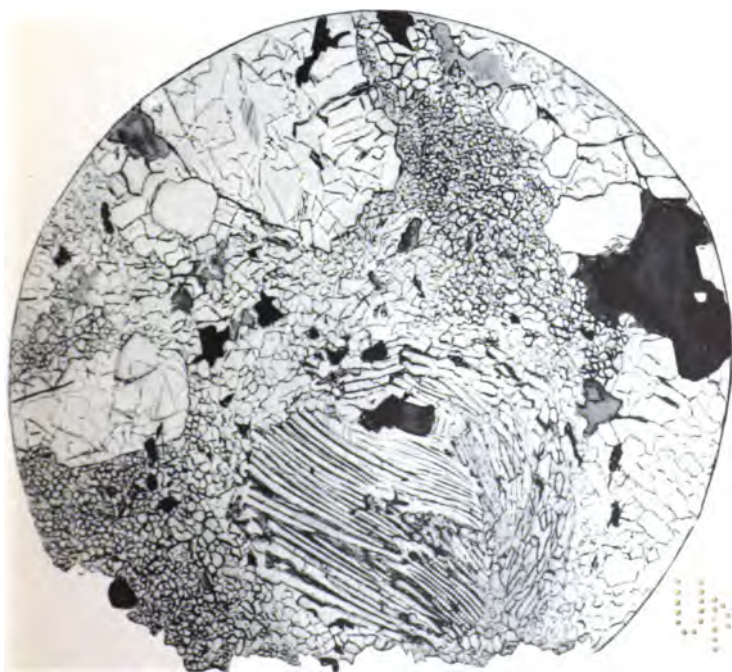
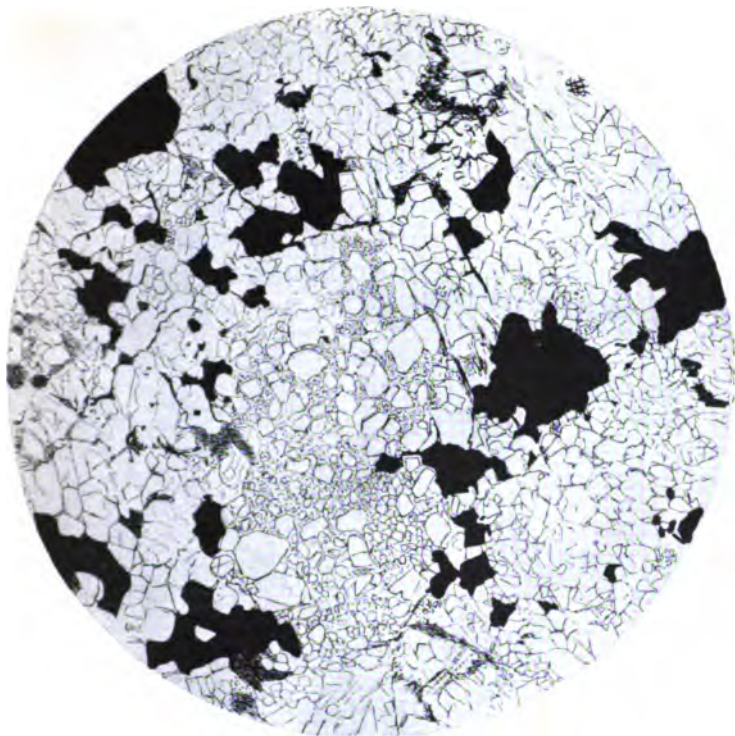


TWO VIEWS OF HENDERSONVILLE STONE, AS FOUND.

FOR DESCRIPTION SEE PAGE 79.



44



**MICROSTRUCTURE OF THE HENDERSONVILLE STONE.**

FOR DESCRIPTION SEE PAGE 79.



## HARRISON COUNTY, INDIANA. No. 56.

Stone, Cho. Eleven grams from a shower which fell March 28, 1859. Gift of J. Berrien Lindsley.

## HARTFORD (MARION), LINN COUNTY, IOWA. Nos. 129, 135.

Stone, Cwa. Two pieces with crust, weighing 23.7 and 41 grams. Fell February 25, 1847. Weight of original mass, 21 kilograms, or 46 pounds. Other masses reported as found, but the disposition of which is unknown. Analysis by Rammelsberg showed:

	Per cent.
Silica ( $\text{SiO}_2$ )	38.95
Alumina ( $\text{Al}_2\text{O}_3$ )	2.04
Ferrous oxide ( $\text{FeO}$ )	14.518
Magnesia ( $\text{MgO}$ )	26.05
Lime ( $\text{CaO}$ )	1.175
Soda ( $\text{Na}_2\text{O}$ )	.384
Iron ( $\text{Fe}$ )	9.46
Nickel ( $\text{Ni}$ )	1.08
Ferrous sulphide ( $\text{FeS}$ )	6.37

---

 100.027

*Reference.*—See Wülfing, p. 139.

## HENDERSONVILLE, HENDERSON COUNTY, NORTH CAROLINA. No. 328.

Stone, Cc. Nearly complete individual, weighing 3.545 kilograms. Weight of original mass, 11 pounds 6 ounces, or 5.17 kilograms. A compact dark gray stone thickly spotted with small points of metallic iron. (See pls. 23 and 24.) Found in 1901, though supposed to have fallen in 1876. Chemical analysis yielded as follows:

	Per cent.
Iron ( $\text{Fe}$ )	2.37
Nickel ( $\text{Ni}$ )	.21
Cobalt ( $\text{Co}$ )	.01
Sulphur ( $\text{S}$ )	1.61
Phosphorus ( $\text{P}$ )	.012
Silica ( $\text{SiO}_2$ )	46.06
Ferrous oxide ( $\text{FeO}$ )	14.33
Alumina ( $\text{Al}_2\text{O}_3$ )	2.20
Chromic oxide ( $\text{Cr}_2\text{O}_3$ )	.23
Lime ( $\text{CaO}$ )	2.13
Magnesia ( $\text{MgO}$ )	28.62
Potash ( $\text{K}_2\text{O}$ )	.10
Soda ( $\text{Na}_2\text{O}$ )	.96
Residue (chromite)	.51

---

 99.352

Approximation of the relative quantities of the different constituents:

	Per cent.
Nickel-Iron .....	2. 59
Trollite .....	4. 43
Schreibersite .....	. 08
Chromite .....	. 80
Olivine .....	40. 48
Pyroxenes .....	51. 62
	<hr/> 100. 00

*Reference.*—G. P. Merrill, Proc. U. S. Nat. Mus., vol. 32, 1907, p. 79. •

HESSLE, NEAR UPSALA, SWEDEN. Nos. 27, 482.

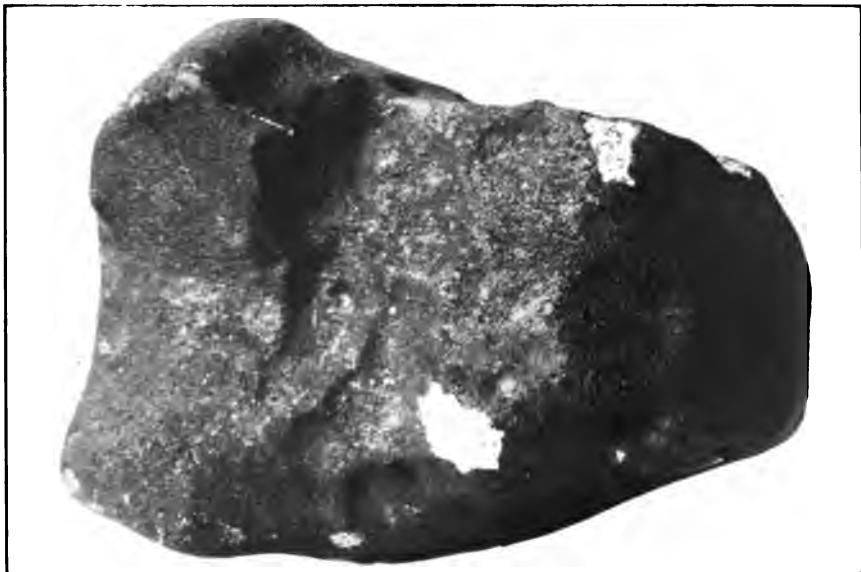
Stone, Cc. Two pieces, one a fragment showing crust and weighing 40 grams, and the second a small completely incrustated individual weighing 11 grams, from a shower comprising many individuals varying in weight from a fraction of a gram to a kilogram, which fell on January 1, 1869. The fall is of interest, being the first recorded fall in Sweden, and, further, (1) from the low velocity with which they struck the earth, Nordenskiöld stating that though the stones were so friable as to be readily broken if thrown against a hard surface, they were not broken or even scarred by the impact of the fall; and (2) from an associated carbonaceous matter which seemed to partake of the nature of a hydrocarbon.

Chemical analyses by the various workers are somewhat variable. In column I below are given results obtained by Nordenskiöld and in column II those of Linström.

Constituents.	I.	II.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica (SiO <sub>2</sub> ) .....	36. 91	36. 83
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	1. 55	2. 39
Ferrous oxide (FeO) .....	13. 43	10. 88
Magnesia (MgO) .....	25. 06	23. 21
Lime (CaO) .....	2. 08	1. 80
Manganous oxide (MnO) .....	.....	. 42
Soda (Na <sub>2</sub> O) .....	1. 57	. 94
Iron (Fe) .....	16. 36	20. 06
Nickel (Ni) .....	2. 16	2. 15
Cobalt (Co) .....	Trace.	. 02
Sulphur (S) .....	. 18	1. 88
Phosphorus (P) .....	Trace.	. 15
Copper and tin (Cu and Sn) .....	. 02	. 02
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ) .....	.....	. 07
	<hr/> 99. 32	<hr/> 100. 80

The mineral composition presents, aside from the hydrocarbon compound, no apparent departure from the ordinary olivine-pyroxene type.





1



2

COMPLETE INDIVIDUALS OF (1) HOLBROOK AND (2) MODOC STONES.

FOR DESCRIPTIONS SEE PAGES 81 AND 108.

*Reference.*—A. E. Nordenskiöld, Kongl. Sven. Vet.-Akad. Handl., vol. 8, No. 9, 1870.

**HEX RIVER, CAPE COLONY, SOUTH AFRICA. No. 311.**

Iron. H. Weight 332 grams. A nearly rectangular slab some 80 by 90 by 6 mm.; etched. Date of fall unknown; found in 1882 and described in 1885. Original weight unknown; 37,704 grams are now in the museum at Vienna and some 7,960 grams are distributed in other collections, making a total weight of 45,644 grams. Analyses, as given by Cohen and Weinschenk.<sup>1</sup> showed: Iron, 93.33; nickel, 5.58; cobalt, 0.84; schreibersite, 0.94.

*Reference.*—See Wülfing, p. 143.

**HOLBROOK, NAVAJO COUNTY, ARIZONA. Nos. 437, 442.**

Stone, Cck. Four nearly complete individuals, weighing 1,035, 895, 447, and 1,120 grams. (Pl. 25, fig. 1.) Fell Friday, July 19, 1912, 7.15 p. m. Several hundred individuals found weighing upward of 218 kilograms, or about 481 pounds. Compact, light gray chondritic stone showing very little metal, but comparatively numerous nodules of troilite. Mineral composition, olivine with monoclinic and orthorhombic pyroxenes and a small amount of glassy material which may be maskelynite. Chemical analysis gave results as below:

	Per cent.
Schreibersite.....	0.11
Troilite.....	7.56
Metal.....	4.85
Silicates.....	87.48
	<hr/> 100.00

**The metallic portion yielded:**

Nickel (Ni).....	8.68
Cobalt (Co).....	.64
Copper (Cu).....	.29
Iron (Fe).....	90.50
	<hr/> 100.11

**The silicate portion yielded:**

Silica (SiO <sub>2</sub> ).....	41.93
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	4.80
Ferrous oxide (FeO).....	21.85
Lime (CaO).....	2.40
Magnesia (MgO).....	29.11
Soda (Na <sub>2</sub> O).....	Trace.
Manganous oxide (MnO).....	0.25
Nickel oxide (NiO).....	.08
	<hr/> 99.92

<sup>1</sup> Ann. k. k. Naturhist. Hofmus., vol. 6, 1891, p. 143.

Recalculated, these results give the following, showing the composition of the stone as a whole:

	Per cent.
Silica ( $\text{SiO}_2$ )	36.68
Alumina ( $\text{Al}_2\text{O}_3$ )	3.76
Ferrous oxide ( $\text{FeO}$ )	19.11
Lime ( $\text{CaO}$ )	2.10
Magnesia ( $\text{MgO}$ )	25.46
Manganous oxide ( $\text{MnO}$ )	.22
Nickel oxide ( $\text{NiO}$ )	.07
Nickel ( $\text{Ni}$ )	.42
Cobalt ( $\text{Co}$ )	.03
Copper ( $\text{Cu}$ )	.01
Iron ( $\text{Fe}$ )	4.39
Ferrous sulphide ( $\text{FeS}$ )	7.58
	<hr/> 99.81

The sulphide separated mechanically yielded:

	Per cent.
Iron	63.62
Sulphur	36.50
	<hr/> 100.12

Specific gravity, 4.61.

These results show the mineral to be troilite and not pyrrhotite.

Gifts of F. C. Chekal and C. S. Bement.

*References.*—G. P. Merrill, Smithsonian Misc. Coll., vol. 60, No. 9, 1912. W. M. Foote, Amer. Journ. Sci., vol. 34, 1912, pp. 437–456.

**HOLLAND'S STORE, CHATTOOGA COUNTY, GEORGIA. Nos. 157, 304.**

Iron Hb. Weight, 142 grams. Thin triangular slice, etched, and showing granular structure, weight, 122 grams, and fragment weighing 20 grams. Found 1887; date of fall unknown. Weight of original mass 12.5 kilos (27 pounds). Analysis by Whitfield showed:

	Per cent.
Iron ( $\text{Fe}$ )	94.60
Nickel ( $\text{Ni}$ )	4.97
Cobalt ( $\text{Co}$ )	.21
Phosphorus ( $\text{P}$ )	.21
	<hr/> 99.99

Chlorine and sulphur present, but not determined. Specific gravity, 7.801. This iron belongs to the hexahedrite group of Brezina, and shows the fine markings due to twinning, known as Neumann lines.

*Reference.*—G. F. Kunz, Amer. Journ. Sci., vol. 34, 1887, p. 471.

**HOMESTEAD, IOWA COUNTY, IOWA. Nos. 11, 21, 423.**

Stone, Cgb. Complete individual with dull black, somewhat blebby crust, weighing 322 grams; fragments, weighing 79 and 230

grams. Fell on the evening of February 12, 1875, at about half past 10 o'clock. Flight was from the south toward the north, about  $18^\circ$  east, and was witnessed over a region at least 400 miles in length, from southwest to northeast, and 250 miles in breadth. The velocity with which it moved has been estimated at a maximum of 10 miles a second. It was described as exploding like a rocket, and detonations followed "so violent as to shake the earth and to jar the windows like the shock of an earthquake." Over 100 irregularly shaped stones were found, the largest of which weighed 74 pounds and the aggregate of which was upward of 500 pounds.<sup>1</sup>

The composition of the stone as determined by J. L. Smith is as follows:

	Per cent.
Stony matter.....	81.64
Troilite .....	5.82
Nickel-iron .....	12.54

Of this stony part there was:

Soluble in acid.....	54.15
Insoluble in acid.....	45.85

Analyses of these portions gave:

Constituents.	Soluble.	Insoluble.
Silica ( $\text{SiO}_2$ ).....	35.61	55.02
Ferrous oxide ( $\text{FeO}$ ).....	27.20	27.41
Magnesia ( $\text{MgO}$ ).....	33.45	13.12
Alkalies (mostly $\text{Na}_2\text{O}$ )....	1.45	2.01
Alumina ( $\text{Al}_2\text{O}_3$ ).....	.71	.84
	98.42	98.40

These analyses show the stony portion to be a mixture of an iron-rich olivine and enstatite. The composition of the metallic portion was found to be:

Iron .....	89.04
Nickel .....	10.84
Cobalt .....	.58

with traces of phosphorus, sulphur, and copper.

This stone has been described by Gümbel, Lasaulx, and Wadsworth. The first named described it as entirely crystalline and fragmental in character. Lasaulx states that it shows an evident brecciated structure, with olivine grains and rounded enstatite masses in a fine-grained groundmass containing grains and fragments of crystals. Wadsworth found no evidence of a fragmental structure, but regarded

<sup>1</sup> Widling says some 700 pounds, the largest of which weighed 120 pounds. I can find no authority for this.

it as the result of rapid cooling of a liquid magma. It was from work upon fragments of this stone that A. W. Wright was enabled to make the important generalizations on gases in stony meteorites mentioned on p. 8.

*References.*—C. W. Gümbel, Sitz k. bayr. Akad. München, 1875, pp. 313–330. A. Lasaulx, Sitz. Niederrh. Ges., 1882, pp. 102–105. M. E. Wadsworth, Lithological Studies, 1884, p. 86.

HONOLULU, HAWAIIAN ISLANDS. No. 278.

Stone, Cwa. Fragment weighing 13.5 grams, showing a portion of the crust. Fell September 27, 1825.

HOPPER, HENRY COUNTY, VIRGINIA. No. 159.

Iron. Twenty-seven grams from a mass weighing 1.7 kilograms, found in 1889. Gift of H. B. Battle.

HVITTIÄ, ÅBO LÄN, FINLAND. No. 406.

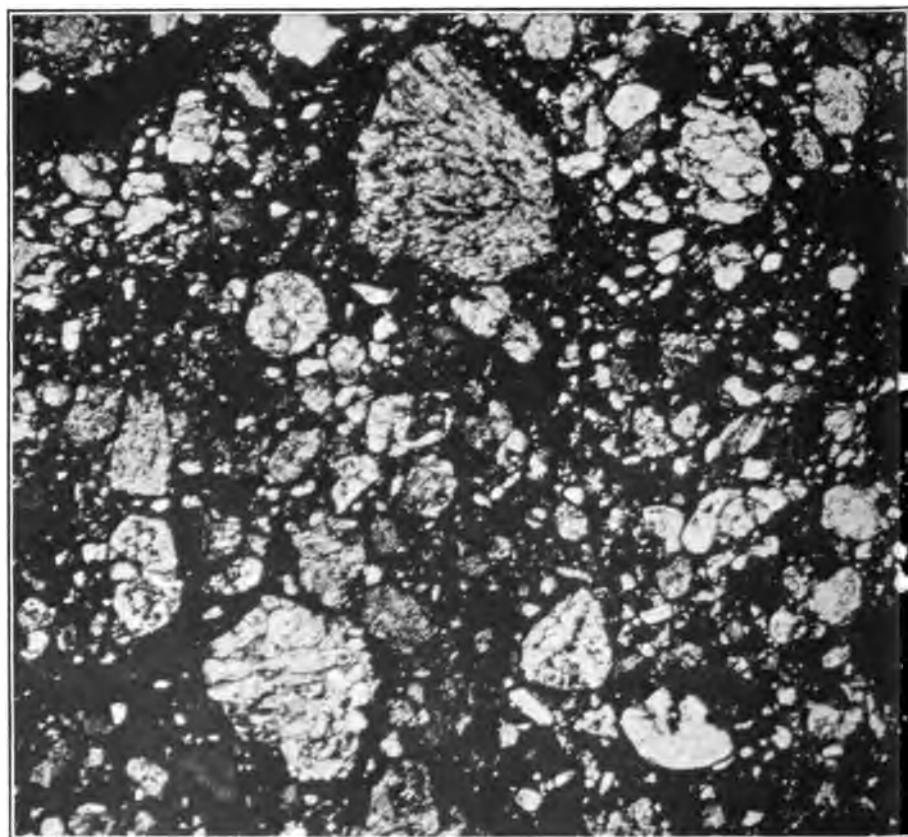
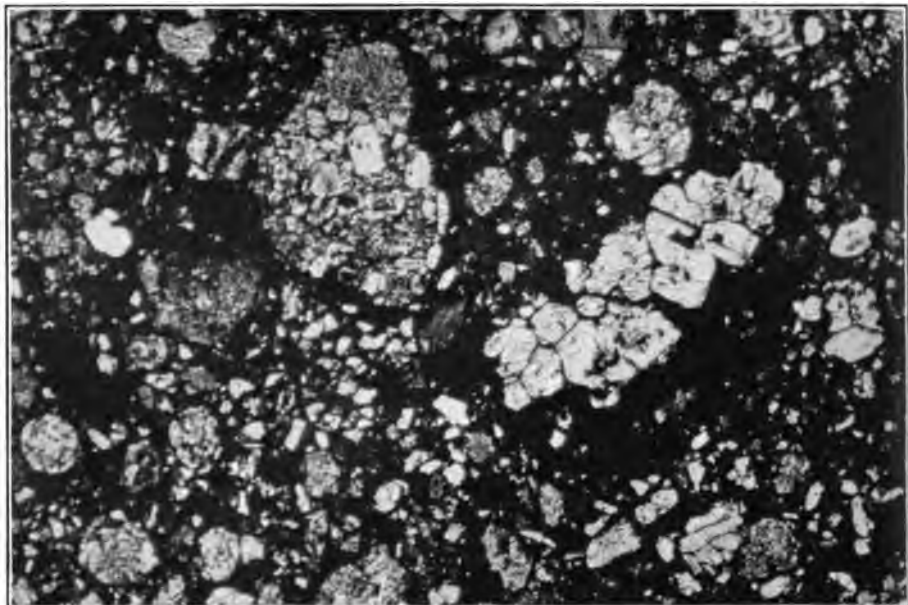
Stone, Cck. Triangular fragment with crust, weighing 70 grams. Fell at midday October 21, 1901. Weight of original mass 14.04 kilograms. This fall was made the subject of an exhaustive study by L. H. Borgström, who from chemical and microscopic studies made the following calculation of its mineral composition:

	Per cent.
Oldhamite .....	0.86
Daubreelite .....	.57
Troilite .....	7.31
Phosphor-nickel-iron .....	.50
Nickel-iron .....	21.50
Enstatite .....	59.01
Orthoclase .....	9.86
Chromite .....	.32
	<hr/> 99.93

The chemical composition was found to be as follows:

	Per cent.
Silica ( $\text{SiO}_2$ ) .....	41.53
Iron (Fe) .....	24.66
Ferrous oxide ( $\text{FeO}$ ) .....	.34
Nickel (Ni) .....	1.96
Cobalt (Co) .....	.07
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	1.55
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ) .....	.57
Lime ( $\text{CaO}$ ) .....	1.41
Magnesia ( $\text{MgO}$ ) .....	23.23
Potash ( $\text{K}_2\text{O}$ ) .....	.32
Soda ( $\text{Na}_2\text{O}$ ) .....	1.26
Sulphur (S) .....	3.30
Phosphorus (P) .....	.08
	<hr/> 100.23





MICROSTRUCTURE OF THE INDARCH STONE.

FOR DESCRIPTION SEE PAGE 85.

*Reference.*—L. H. Borgström, Die Meteoriten von Hvittis und Marjalahti. Bull Comm. geol. Finlande, No. 14, 1903.

**ILIMAE, DESERT OF ATACAMA, CHILE. No. 333.**

Stony-iron, Pallasite. Fragment weighing 155 grams. From a mass weighing 51.7 kilograms found in 1870. Gift of George P. Merrill.

*Reference.*—L. Fletcher, Min. Mag., vol. 8, No. 40, 1889, p. 223.

**IMILAC, ATACAMA, CHILE. Nos. 6, 7, 8.**

Stony-iron, Pallasite. Three pieces weighing, respectively, 34, 60, and 194 grams. Found early in the nineteenth century, but nothing known regarding fall.

*Reference.*—L. Fletcher, Min. Mag., vol. 8, No. 40, 1889, p. 223.

**INDARCH, NEAR GINDORCHA, RUSSIA. Nos. 334, 449.**

Stone, Kc. Two fragments weighing, respectively, 33 and 261 grams. Fell April 7, 1891. (Pl. 26.) Total weight of fall, 27 kilograms, or 59.4 pounds. One of the carbonaceous chondrites, and of interest in that it carries the rare calcium sulphide oldhamite. The chemical composition, as determined by J. E. Whitfield, is as follows:

	Per cent.
Silica ( $\text{SiO}_2$ )	35.699
Alumina ( $\text{Al}_2\text{O}_3$ )	1.969
Ferrous oxide ( $\text{FeO}$ )	14.350
Manganous oxide ( $\text{MnO}$ )	.180
Nickel oxide ( $\text{NiO}$ )	.549
Cobalt oxide ( $\text{CoO}$ )	.049
Lime ( $\text{CaO}$ )	1.160
Magnesia ( $\text{MgO}$ )	16.920
Carbonic acid ( $\text{CO}_2$ )	.271
Phosphoric acid ( $\text{P}_2\text{O}_5$ )	.520
Water ( $\text{H}_2\text{O}$ )	2.799
Iron ( $\text{Fe}$ )	10.400
Nickel ( $\text{Ni}$ )	.949
Cobalt ( $\text{Co}$ )	.020
Phosphorus ( $\text{P}$ )	.092
Manganese ( $\text{Mn}$ )	.119
Carbon (graphite) ( $\text{C}$ )	.310
Iron and calcium sulphide ( $\text{FeS}$ and $\text{CaS}$ )	14.000
	<hr/> 100.308

No barium, strontium, or zirconium detected.

The mineral composition is:

	Per cent.
Silicate (enstatite)	74.42
Metal	11.50
Troilite and oldhamite	14.00
Graphite	.31
	<hr/> 100.23

*Reference.*—G. P. Merrill, Proc. U. S. Nat. Mus., vol. 49, 1915, p. 109.

**IREDELL, BOSQUE COUNTY, TEXAS. No. 261.**

Iron, H. Weight, 98 grams; rough fragment with small surface etched showing granular structure and fine Neumann lines. Date of fall unknown; found 1898. The mass has been broken up and distributed, the total weight of known fragments being but 500 grams. Iron soft and takes a high polish. Composition, according to Whitfield:

	Per cent.
Iron (Fe)-----	93.75
Nickel (Ni)-----	5.51
Cobalt (Co)-----	.52
Phosphorus (P)-----	.20
Sulphur (S)-----	.06
	<hr/> 100.04

*Reference.*—W. M. Foote, Am. Journ. Sci., vol. 8, 1898, pp. 415, 416.

**ITAPICURU-MIRIM, MARANHÃO, BRAZIL. No. 110.**

Stone, Cc. Weight, 9.7 grams. Fell in March, 1879.

**IVANPAH, SAN BERNARDINO COUNTY, CALIFORNIA. No. 73.**

Iron, Om. Seventy grams of turnings from a mass found in 1880.

**JAMESTOWN, STUTSMAN COUNTY, NORTH DAKOTA. No. 340.**

Iron, Of. Slice 11 by 2 cm. by 5 mm., weighing 83 grams. Portion of a mass, weighing 4,015 grams, found in 1885. Date of fall unknown. Analysis by Huntington yielded:

	Per cent.
Iron (Fe)-----	90.24
Nickel (Ni)-----	9.75
Phosphorus (P)-----	.05
Copper (Cu)-----	trace
	<hr/> 100.04

*Reference.*—O. W. Huntington, Proc. Amer. Acad. Arts and Sci., vol. 25, 1890, p. 229.

**JELIOA, SERBIA. No. 315.**

Stone, Am. Weight, 16 grams; fragments with crust; shows a gray, brecciated interior with chondrules. Fell at 2 p. m., Decem-

ber 1, 1889; a shower of stones over an area some 8 kilometers long by 5 kilometers broad. Twenty-six stones were found, weighing altogether 33.83 kilograms. Twenty-five of these, weighing 30.83 kilograms, are still in the museum at Belgrade. This stone belongs to the group of amphoterites of which but three representatives are known. Chemical analysis by S. M. Losanitsch yielded:

	Per cent.
Iron (Fe)-----	1.61
Nickel (Ni)-----	.83
Cobalt (Co)-----	.05
Copper (Cu)-----	Trace.
Iron-sulphide (FeS?)-----	7.09
Chromite (FeOCr <sub>2</sub> O <sub>3</sub> )-----	.73
Silica (SiO <sub>2</sub> )-----	39.72
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	1.88
Magnesia (MgO)-----	25.34
Lime (CaO)-----	1.23
Ferrous oxide (FeO)-----	21.29
Manganese oxide (Mn <sub>2</sub> O <sub>3</sub> )-----	.21
Alkalies and organic matter-----	.12
	<hr/> 100.10

From these results the mineralogical composition was calculated as:

	Per cent.
Metal-----	2.49
Troilite-----	7.09
Chromite-----	.73
Soluble silicates (mainly olivine)-----	54.00
Insoluble silicates (mainly pyroxene)-----	36.25
	<hr/> 100.56

*Reference.*—S. M. Losanitsch, Ber. Deut. Chem. Ges., vol. 25, No. 128, 1892, p. 876.

**JENNY'S CREEK, WAYNE COUNTY, WEST VIRGINIA. No. 44.**

Iron, Ogb. Twenty-two grams in fragments from one of three masses weighing 23 pounds, found in 1883.

**JEROME, GOVE COUNTY, KANSAS. No. 218.**

Stone Ckb. Weight 110 grams. Section of mass, one surface polished, shows fine granular compact mass, with numerous small grains of nickel-iron and many olivine and bronzite chondrules. Found April 10, 1894. Date of fall unknown. Total weight found 65½ pounds, or about 30 kilograms. The chemical composition as determined by H. S. Washington is:

	Per cent.
Silica ( $\text{SiO}_2$ )	33.11
Titanic oxide ( $\text{TiO}_2$ )	Traces.
Chromic oxide ( $\text{Cr}_2\text{O}_3$ )	.58
Alumina ( $\text{Al}_2\text{O}_3$ )	1.77
Ferrous oxide ( $\text{FeO}$ )	27.97
Iron ( $\text{Fe}$ )	3.81
Nickel oxide ( $\text{NiO}$ )	1.77
Nickel ( $\text{Ni}$ )	.43
Cobalt oxide ( $\text{CoO}$ )	Trace.
Cobalt ( $\text{Co}$ )	0.01
Manganous oxide ( $\text{MnO}$ )	Trace.
Magnesia ( $\text{MgO}$ )	21.59
Lime ( $\text{CaO}$ )	1.31
Soda ( $\text{Na}_2\text{O}$ )	.65
Potash ( $\text{K}_2\text{O}$ )	.28
Ignition ( $\text{H}_2\text{O}$ )	3.03
Phosphoric acid ( $\text{P}_2\text{O}_5$ )	.37
Sulphur ( $\text{S}$ )	1.88
Extra ( $\text{O}$ )	1.76
	<hr/>
	100.32
Less O for S	.92
	<hr/>
	99.40

From this and the study of thin sections the mineral composition was calculated as below:

	Per cent.
Nickel-iron	4.3
Trollite	5.2
Chromite	.9
Schreibersite (?)	.8
Olivine	30.2
Bronzite	23.6
Pyroxene	5.0
Oligoclase	6.6
Orthoclase	1.6
Limonite	20.2
Nickel oxide	1.6
	<hr/>
	100.0

*Reference.*—H. S. Washington, Amer. Journ. Sci., vol. 5, 1898, p. 447.

**JEWELL HILL, MADISON COUNTY, NORTH CAROLINA. No. 58.**

Iron, Og. One gram.

**JHUNG, PUNJAUB, INDIA. No. 72.**

Stone, Ca. 1.22 grams. Fell in June, 1873.

## JIGALOWKA, CHARKOW, RUSSIA. No. 172.

Stone, Cwa. 26.2 grams from a mass weighing 1,300 grams which fell on October 13, 1787.

## JOE WRIGHT MOUNTAIN, INDEPENDENCE COUNTY, ARKANSAS. Nos. 139, 354.

Iron, Om. Two pieces weighing 309 grams and 115 grams. Found 1884; date of fall unknown. Weight of original mass 42.5 kilograms or 94 pounds. Incomplete analysis shows the approximate composition to be:

	Per cent.
Iron .....	91.22
Phosphorus .....	.16
Nickel and cobalt (by difference) .....	8.62
	100.00

*Reference.*—W. E. Hidden, Amer. Journ. Sci., vol. 31, 1886, p. 460.

## JUVINAS, DEPARTMENT L'ARDECHE, FRANCE. No. 439.

Stone, Eu. Weight 100 grams. Fell June 15, 1821. Weight of original mass 91 kilograms, or 200 lbs. Analysis I by J. E. Whitfield, and II by C. Rammelsberg yielded:

Constituents.	I.	II.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica ( $\text{SiO}_2$ ) .....	47.99	49.23
Titanic oxide ( $\text{TiO}_2$ ) .....	.57	.10
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	13.50	12.55
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ) .....	.22	1.21
Iron (Fe) .....	Trace.	.16
Nickel oxide (NiO) .....	0.11	.....
Cobalt oxide (CoO) .....	Trace.	.....
Ferrous oxide (FeO) .....	18.63	20.33
Lime (CaO) .....	10.60	10.23
Magnesia (MgO) .....	7.20	6.44
Barium oxide (BaO) .....	None.	.....
Strontium oxide (SrO) .....	None.	.....
Zirconium oxide (ZrO) .....	None.	.....
Potash ( $\text{K}_2\text{O}$ ) .....	None.	.12
Soda ( $\text{Na}_2\text{O}$ ) .....	0.55	.63
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ) .....	Trace.	.24
Phosphoric acid ( $\text{P}_2\text{O}_5$ ) .....	None.	.28
Sulphur (S) .....	0.054	.09
Sulphuric anhydride ( $\text{SO}_3$ ) .....	.02	.....
	99.444	101.61

*References.*—C. Rammelsberg, Ann. Phys. Chem., vol. 73, 1848, p. 585. G. P. Merrill, Mem. Nat. Acad. Sci., vol. 14, 1916, p. 14.

## KARAKOL, KIRGHIS STEPPES, RUSSIA. No. 175.

Stone, Cw. Fragment with crust, weighing 5 grams, from a stone weighing 3 kilograms, which fell May 9, 1840.

## KENDALL COUNTY, TEXAS. Nos. 255, 242.

Iron, Hb. Two pieces, one of 767 grams and one of 1,165 grams. Ends of mass with original and etched surfaces, showing brecciated structure, and schreibersite and troilite (pl 20, fig. 1). From a mass weighing 20.883 kilograms, or nearly 46 pounds, found in 1887. Nothing known regarding fall. Analysis by Scherer yielded:

	Per cent.
Iron (Fe).....	92.65
Nickel (Ni).....	5.64
Cobalt (Co).....	.78
Copper (Cu).....	.03
Chromium (Cr).....	.01
Carbon (C).....	1.62
Phosphorus (P).....	.34
Sulphur (S).....	.03
Chlorine (Cl).....	.01
	<hr/> 101.11

From this the mineral composition is calculated as:

	Per cent.
Nickel-iron.....	96.11
Schreibersite.....	2.19
Carbon.....	1.60
Daubreelite.....	.03
Troilite.....	.05
Lawrencite.....	.02
	<hr/> 100.00

*Reference.*—E. Cohen, Ann. k. k. Naturhist. Hofmus., vol. 15, 1900, p. 382.

## KENTON COUNTY, KENTUCKY. No. 206.

Iron, Om. Slice 4 by 4 cm., weighing 146 grams. Shows faint Widmanstätten figures and grains of troilite. From a mass weighing 163 kilograms, or 368½ pounds. Found in 1889. Date of fall uncertain; thought possibly to be July 7, 1873. Analysis by Davison yielded:

	Per cent.
Iron (Fe).....	91.59
Nickel (Ni).....	7.65
Cobalt (Co).....	.84
Carbon (C).....	.12
	<hr/> 100.20

with traces of copper, phosphorus, and sulphur.

*Reference.*—H. L. Preston, Amer. Journ. Sci., vol. 44, 1892, p. 163.

**KERNOUVÉ, MORBIHAN, BRITTANY FRANCE. No. 349.**

Stone, Ck. Fragment weighing 567 grams, from a stone weighing 80 kilograms, or 176 pounds, which fell on May 22, 1869. An analysis by M. F. Pisani yielded:

	Per cent.
Iron (Fe) .....	22.25
Nickel (Ni) .....	1.55
Sulphur (S) .....	2.15
Copper (Cu) .....	Traces.
Chrome-iron ( $\text{Cr}_2\text{O}_3 + \text{FeO}$ ) .....	Traces.
Silica ( $\text{SiO}_2$ ) .....	82.95
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	3.19
Iron protoxide ( $\text{FeO}$ ) .....	11.70
Magnesia ( $\text{MgO}$ ) .....	23.68
Lime ( $\text{CaO}$ ) .....	1.89
Soda ( $\text{Na}_2\text{O}$ ) (traces of potash ( $\text{K}_2\text{O}$ )) .....	1.41
	<hr/> 100.77

*Reference.*—F. Pisani, Compt. Rend., vol. 68, 1869, p. 1489.

**KESEN, IWATE, JAPAN. Nos. 300, 418.**

Stone, Ccb. Fragments weighing 208 grams and 318 grams, with dull black crust. Surface blebby and indented with broad, shallow pits. Polished surface ash gray, granular, and compact, traversed by black veins. Fell June 13, 1850. Known weight, 7,088 grams. Several fragments were found buried in the ground. Analysis by Kondo yielded:

	Per cent.
Silica ( $\text{SiO}_2$ ) .....	35.98
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	16.51
Ferrous oxide ( $\text{FeO}$ ) ..	
Magnesia ( $\text{MgO}$ ) .....	22.63
Lime ( $\text{CaO}$ ) .....	2.20
Soda ( $\text{Na}_2\text{O}$ ) .....	.86
Potash ( $\text{K}_2\text{O}$ ) .....	.60
Iron (Fe) .....	12.79
Nickel and cobalt (Ni and Co) .....	2.82
Phosphorus (P) .....	.31
Manganese (Mn) .....	.21
Ferrous sulphide ( $\text{FeS}$ ) .....	5.75
	<hr/> 99.66

*Reference.*—Kotora Jimbo, Beitr. Min. Japan, No. 2, February, 1906, p. 37.

**KNYAHINYA, HUNGARY. Nos. 102, 341, 404.**

Stone, Cg. Fragments and complete individuals with crust, weighing 27.8, 205, 211, and 405.8 grams. Fell June 9, 1866. Groundmass

ash gray, granular, compact. Structure chondritic. Original fall over 1,000 stones, weighing upward of 500 kilograms, or 1,100 pounds. This is one of the most interesting of stony meteorites owing to the very full data compiled by Haidinger regarding its fall, as well as on account of the number of stones. It was studied in thin sections by Kenngott in 1869, who recognized the presence of enstatite, olivine, troilite, and native iron. These results have since been confirmed by Wadsworth. Analysis (recalculated from Baumhauer) yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	44.30
Alumina ( $\text{Al}_2\text{O}_3$ )	3.057
Ferrous oxide ( $\text{FeO}$ )	16.379
Lime ( $\text{CaO}$ )	2.727
Magnesia ( $\text{MgO}$ )	22.16
Soda ( $\text{Na}_2\text{O}$ )	1.00
Potash ( $\text{K}_2\text{O}$ )	.658
Chromic oxide and ferrous oxide ( $\text{Cr}_2\text{O}_3$ and $\text{FeO}$ )	.80
Ferrous sulphide ( $\text{FeS}$ ) (recalculated)	2.22
Iron and nickel ( $\text{Fe}$ and $\text{Ni}$ ) (recalculated)	5.00
	<hr/> 98.301

It was in this meteorite that Dr. Otto Hahn thought to have discovered fossil remains of sponges, corals, and crinoids. The fall is of further interest from the fact that it included one of the largest stone meteorites known, a mass weighing 294 kilograms (647 pounds), which is now preserved in the Vienna Museum.

*References.*—W. Haidinger, Sitz. Akad. Wiss. Wien, vol. 54, pt. 2, 1866, pp. 200, 475–522. E. H. v. Baumhauer, Archiv. Néerl., vol. 7, 1872, p. 146. Wadsworth, Lithological Studies, 1884, p. 88.

KODAIKANAL, PALNI HILLS, MADRAS, INDIA. No. 317.

Iron, Obk. Thin slab weighing 90 grams.

KRASNOJARSK, JENISEISK, SIBERIA. No. 331.

Stony-iron, Pallasite. Rough fragment, a coarse mesh of iron with included olivines, weighing 287 grams. The fragment represents historically one of the most interesting meteorites. It was found by a Cossack in 1749 on the surface of the highest point of a lofty mountain between Krasnojarsk and Abakansk in Siberia, where it was regarded by the natives as a holy thing fallen from heaven. It was first made known to the scientific world by the explorer Pallas in 1772. The original mass weighed about 1,500 pounds, the largest portion of which is in the museum at St. Petersburg. It has been the subject of numerous investigations. The olivine presents a perfection of crystal

outlines quite unusual, some 19 faces having been detected. Chemical analysis of the mineral by Baumhauer yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	40.87
Magnesia ( $\text{MgO}$ )	46.96
Iron ( $\text{Fe}$ )	12.11

---

99.94

which is almost the theoretical composition of this species. Rumler thought to have detected the presence of arsenic, but this has not been borne out by subsequent investigation. The metallic portion was analyzed by J. E. Whitfield, who reported:

	Per cent.
Iron ( $\text{Fe}$ )	89.90
Nickel ( $\text{Ni}$ )	9.52
Cobalt ( $\text{Co}$ )	.60
Phosphorus ( $\text{P}$ )	.085

---

100.105

but no tin, though the last named had been reported by Reichenbach..

*Reference.*—See Wülfing, p. 187.

**KRASNOJ-UGOL, RASAN, RUSSIA. No. 184.**

Stone, Cc. Six grams from the interior. Fell September 9, 1829.

**KULESCHOWKA, POLTAWA, RUSSIA. No. 173.**

Stone, Cwa. Two fragments weighing 5.5 grams. Fell March 12, 1811.

**LA BÉCASSE, INDRE, FRANCE. No. 370.**

Stone, Cw. Weight 76 grams. Fragment from a stone weighing 2.8 kilograms, or 6 pounds, which fell January 31, 1879.

**LA GRANGE, OLDHAM COUNTY, KENTUCKY. No. 55.**

Iron, Of. Weight 172 grams. From a mass weighing 51 kilograms, or 112 pounds, found in 1860. Analysis by J. L. Smith showed it to contain:

	Per cent.
Iron ( $\text{Fe}$ )	91.21
Nickel ( $\text{Ni}$ )	7.81
Cobalt ( $\text{Co}$ )	.25
Copper ( $\text{Cu}$ )	Minute quantity, not estimated.
Phosphorus ( $\text{P}$ )	.05

---

99.32

Gift of J. Berrien Lindsley.

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 31, 1861, p. 264.

## L'AIGLE, ORNE, FRANCE. Nos. 50 and 435.

Stone, Cib. Two fragments, weighing 56 and 27 grams, with brownish-black crust, stained by iron oxides. Groundmass ash-gray, also stained, compact, granular, chondritic. Fell about 1 p. m. April 26, 1803, the course being from the southeast to the northwest. Fall accompanied by the usual phenomena. Between 2,000 and 3,000 stones fell over an ellipsoidal area some 2½ French miles in greatest diameter, the aggregate weight being not less than 36,843 grams. Analysis by E. H. v. Baumhauer showed the stone to consist of:

	Per cent.
Nickel-iron.....	8.0
Pyrrhotite.....	1.8
Chromite.....	.6
Olivine.....	45.3
Pyroxene.....	44.3
	<hr/> 100.0

with a trace of calcium sulphate.

Specific gravity on different samples varied from 3.279 to 3.626.

This fall is of interest since it took place at a time when there was still great doubt in the minds of even scientific men as to whether or no stones did actually fall from the skies. As Chladni himself wrote:

Kam der fall von L'Aigle gerade zur rechten Zeit, um so Manchen zum glauben an das Neiderfallen Meteorischen Massen zu nothigen.

Fletcher writes:

Whilst the minds of the scientific men of France were in this unsettled condition there came a report that still another shower of stones had fallen, this time in their own country, and within easy reach of Paris. To settle the matter finally, if possible, the physicist Biot, member of the French Academy, was directed by the minister of the interior to inquire into the event upon the spot. After a careful examination of the stones and a comparison of the statements of the villagers, Biot was convinced that—

1. On Tuesday, April 26, 1803, about 1 p. m., there was a violent explosion in the neighborhood of L'Aigle, in the department of Orne, lasting for five or six minutes. This was heard for a distance of 75 miles around.

2. Some minutes before the explosion at L'Aigle a fireball in quick motion was seen from several of the adjoining towns, though not from L'Aigle itself.

3. There was absolutely no doubt that on the same day many stones fell in the neighborhood of L'Aigle.

Biot estimated the number of the stones at 2,000 or 3,000. They fell within an ellipse of which the larger axis was 6.2 miles and the smaller 2.5 miles, and this inequality might indicate not a single explosion but a series of them. With the exception of a few little clouds of ordinary character the sky was quite clear.<sup>1</sup>

The exhaustive report of Biot and its conclusive nature compelled the whole of the scientific world to recognize the fall of stones on the earth from outer space as an undoubted fact.

*Reference.*—H. Pfahler, Ueber den Meteoriten von L'Aigle, 26 April, 1803. Min. pet. Mitth., vol. 13, 1893, p. 362.

<sup>1</sup> *Mémoires de l'Institut National de France*, vol. 7, pt. 1, 1806, p. 224.

## LANÇON, LOIRE-ET-CHER, FRANCE. No. 381.

Stone, Cc. Fragment weighing 93 grams, from a shower of six stones weighing in the aggregate 51.75 kilograms, or 114 pounds, which fell on July 23, 1872. Analysis showed it to consist of:

	Per cent.
Nickel-iron .....	7.81
Iron and other metals combined with sulphur .....	9.09
Sulphur combined as above .....	5.19
Silica .....	17.20
Iron protoxide .....	11.33
Manganese .....	.05
Magnesia .....	13.86
Sodium chloride .....	.12
Insoluble constituents .....	33.44
Hygrometric water .....	1.24
	<hr/> 99.33

The above is interesting on account of the reported occurrence of sodium chloride. There is a doubt, however, as to the correctness of this.

*Reference.*—W. Flight, *History of Meteorites*, 1887, p. 54.

## LANÇON, BOUCHES-DU-RHÔNE, FRANCE. No. 382.

Stone, Cia. Fragment from interior weighing 72 grams. One face polished, showing chondrules and metallic grains. Fell on June 20, 1897. An analysis by Meunier showed:

	Per cent.
Nickel-iron .....	8.80
Pyrrhotite .....	6.35
Chromite .....	.54
Enstatite (with plagioclase) .....	52.21
Olivine (by difference) .....	32.10
	<hr/> 100.00

*Reference.*—S. Meunier, *Compt. Rend.*, vol. 131, 1900, pp. 969–972.

## LENARTO, GALICIA, AUSTRIA. No. 450.

Iron, Om. Slice, 50 by 65 by 5 mm., weighing 132 grams. From a mass weighing 1,086 kilograms reported to have fallen in 1814. This, however, considered doubtful. Chemical analysis by W. S. Clark showed:

	Per cent.
Iron (Fe) .....	90.153
Nickel (Ni) .....	6.553
Cobalt (Co) .....	.502
Manganese (Mn) .....	.145
Copper (Cu) .....	.08
Tin (Sn) .....	.082
Sulphur (S) .....	.482
Iron phosphide .....	1.226
	<hr/> 99.223

This iron was investigated by Thomas Graham and found to yield 2.85 times its volume of gas, of which 85.68 was hydrogen, 4.46 carbon monoxide, and 9.86 nitrogen.

*References.*—W. S. Clark, Dissertation on Meteorites, 1852, p. 39. T. Graham, Compt. Rend., vol. 64, 1867, p. 1067.

LEXINGTON COUNTY, SOUTH CAROLINA. No. 10.

Iron, Og. Weight, 45 grams. Fragment showing octahedral structure. Date of fall unknown; found 1880. Weight of original mass, 4,750 grams.

Analysis yielded, for the iron:

	Per cent.
Iron (Fe), with traces of manganese (Mn)-----	92.416
Nickel (Ni)-----	6.077
Cobalt (Co)-----	.927
Insoluble matter-----	.264
	<hr/> 99.684

Specific gravity, 7; of the iron freed from troilite and schreibersite, 7.405.

*Reference.*—C. U. Shepard, Meteoric iron from South Carolina. Amer. Journ. Sci., vol. 21, 1881, p. 117.

LICK CREEK, DAVIDSON COUNTY, NORTH CAROLINA. No. 413.

Iron, H. Irregular mass, 35 by 18 by 12 mm., weighing 18 grams, from a mass weighing 1.24 kilograms, found in 1879.

LIME CREEK, NEAR OLAIBORNE, MONROE COUNTY, ALABAMA. No. 379.

Iron, H. A slice, 8 by 5 by 2 cm., weighing 523 grams, from a mass weighing 40.888 kilograms. Found about 1833 or 1834, and nothing known regarding fall. The iron is of historical interest, being the first in which iron protochloride was discovered, which was later named lawrencite.

*References.*—C. T. Jackson, Amer. Journ. Sci., vol. 34, 1838, p. 332; also vol. 48, 1845, p. 145.

LIMERICK, ADARE, IRELAND. No. 946.

Stone, Cga. Weight, 24 grams. Fragment from interior, showing black veins and slickensided surfaces. Fell September 10, 1813, about 6 o'clock in the morning. Original weight, 106 pounds, according to Wülfing. The composition, as made out by Apjohn, is:

	Per cent.
Iron and nickel-----	23.07
Pyrrhotite-----	4.38
Chromite-----	3.34
Earthy matrix-----	68.47
Alkalies and loss-----	.74
	<hr/> 100.00

Specific gravity, 3.621 to 4.23. The "earthy matrix," as indicated by the analysis, is composed mainly of olivine and pyroxene. Color, gray.

*Reference*.—James Apjohn, Trans. Royal Irish Acad., vol. 18, 1837, pp. 17–30.

**LION RIVER, GREAT NAMAKUALAND, SOUTH AFRICA. No. 59.**

Iron, Of. Weight, 34.87 grams. Date of fall unknown. Brought to London in 1852 and thence transferred to the Shepard collection at Amherst, Massachusetts. Original weight, 80.5 kilograms (178 pounds). Shepard's analysis yielded:

	Per cent.
Nickel .....	6.70
Iron with traces of phosphorus, sulphur, tin, and potassium .....	93.80
	<hr/> 100.00

Other analyses made at intervals, by von Baumhauer and van der Boon Mesch (1866) and by Sjöström, as given by Cohen (*Meteoriten Studien*, 1897, p. 43), show a considerable variation. The latest, by Sjöström, gave results as follows:

	Per cent.
Iron (Fe) .....	92.06
Nickel (Ni) .....	7.79
Cobalt (Co) .....	.69
Phosphorus (P) .....	.05
	<hr/> 100.59

*References*.—C. U. Shepard, Amer. Journ. Sci., vol. 15, 1853, p. 1; E. Cohen, Ann. k. k. Naturhist. Hofmus., vol. 12, 1897, p. 43.

**LISSA, BUNZLAU, BOHEMIA, AUSTRIA. No. 228.**

Stone, Cwa, sometimes Cwb. Weight, 47 grams. Fell September 3, 1808, the fall being accompanied by the usual reports, but no light observed. Four or five stones fell, weighing altogether 10,366 grams. Analysis by Klaproth, as quoted by Buchner (*Die Meteoriten in Sammlungen*, 1863, p. 27), yielded:

	Per cent.
Silica (SiO <sub>2</sub> ) .....	43.00
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	1.25
Magnesia (MgO) .....	22.00
Lime (CaO) .....	.50
Iron (Fe) .....	29.09
Nickel (Ni) .....	.50
Manganous oxide (MnO) .....	.25
Sulphur (S) and loss .....	3.50
	<hr/> 100.00

A fine-grained, light gray, chondritic stone with pyrrhotite and metallic particles visible to the unaided eye. Stone traversed by fine dark veins.

*References.*—K. von Schreiberg, Gilbert's Ann. Phys., vol. 30, 1808. O. Buehner, Die Meteoriten in Sammlungen, 1863, p. 26.

**LLANO DEL INCA, 35 LEAGUES SOUTHEAST OF TOLTAL, ATACAMA, CHILE. No. 134.**

Stony-iron, M. Weight, 66 grams, from a mass weighing 3,145 grams found in 1888.

**LODHRAH, PUNJAB, EAST INDIA. No. 461.**

Stone, Lo. Fragments from interior weighing 17.52 grams. Fell October 1, 1868. Is of interest on account of its granular and friable nature and the unusual crystallographic development of the olivine and bronzite. The mineral composition, as determined by Tschermak, is:

	Per cent.
Nickel-iron .....	32.5
Olivine .....	28.9
Bronzite with some chromite and anorthite .....	31.2
Pyrrhotite .....	7.4
	<hr/> 100.00

*Reference.*—G. Tschermak, Sitz. Akad. Wiss. Wien, vol. 61, 1870, p. 465.

**LONG ISLAND, PHILLIPS COUNTY, KANSAS. No. 211.**

Stone, Cia. Weight, 1,893 grams; in three pieces, (A) weighing 493 grams, having a slickensided surface, later smoothed to a smooth brown crust; (B) weighing 159 grams; and (C) weighing 1,241 grams. All have surfaces much oxidized and in places encrusted with calcium carbonate. Date of fall unknown; found in 1891. Original weight some 936 kilograms, of which the larger portion, in many pieces, is in the collections of the Field Columbian Museum. Described by Weinschenk as a dark green stone showing metallic iron, with crystalline structure (rarely chondritic) plainly evident to the unaided eye. The mineral composition is given as olivine and bronzite, sometimes the one and sometimes the other prevailing, rarely a monoclinic pyroxene (diplage), pyrrhotite, chromite, and metallic iron. Analysis by H. W. Nichols yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	35.65
Alumina ( $\text{Al}_2\text{O}_3$ )	3.08
Ferrous oxide ( $\text{FeO}$ )	22.85
Magnesia ( $\text{MgO}$ )	22.74
Lime ( $\text{CaO}$ )	1.40
Soda ( $\text{Na}_2\text{O}$ )	.25
Potash ( $\text{K}_2\text{O}$ )	.08
Iron ( $\text{Fe}$ )	2.60
Nickel ( $\text{Ni}$ )	.67
Cobalt ( $\text{Co}$ )	.04
Sulphur ( $\text{S}$ )	1.80
Phosphorus ( $\text{P}$ )	.06
	<hr/> 91.27

*References.*—E. Weinschenk, Min. pet. Mitth., vol. 14, 1895, p. 471.  
O. C. Farrington, Field Col. Mus. Publ., Geol. Ser., vol. 1, 1902, p. 297.

**LOTTTOWN, CHEROKEE COUNTY, GEORGIA. Nos. 33, 411.**

Iron, Om. Thirteen grams from a mass weighing 300 grams, found in 1867.

**LUIS LOPEZ, SOCORRO COUNTY, NEW MEXICO. Nos. 217, 451.**

Iron, Om. Fragment 2 by 5 cm., weighing 22 grams, and an irregular slice 35 by 75 mm., weighing 118 grams, from a mass weighing 6,903 grams found in 1896. Chemical analysis by Mariner and Hoskins yielded:

	Per cent.
Iron ( $\text{Fe}$ )	91.312
Nickel ( $\text{Ni}$ )	8.170
Cobalt ( $\text{Co}$ )	.160
Silicon ( $\text{Si}$ )	Trace.
Phosphorus ( $\text{P}$ )	.333
Sulphur ( $\text{S}$ )	.013
Carbon ( $\text{C}$ )	.012
	<hr/> 100.000

*Reference.*—H. L. Preston, Amer. Journ. Sci., vol. 9, 1900, p. 283.

**LUMPKIN, STEWART COUNTY, GEORGIA. No. 265.**

Stone, Cck. Weight, 29 grams. Fragment with crust; compact, fine gray ground with darker chondrules; metallic portion evident only in small glittering points. Fell on the morning of October 6, 1869; original weight, 357 grams ( $12\frac{3}{4}$  oz.). Analyses by J. Lawrence Smith showed: Metallic portion, 7 per cent. This yielded:

Iron, 86.92; nickel, 12.01; cobalt, 0.75. Analyses of the silicate portion yielded:

Constituents.	Soluble in HCl 58.06.	Insoluble in HCl 41.96.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica (SiO <sub>2</sub> ).....	41.08	58.08
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	.32	5.89
Ferrous oxide (FeO).....	18.45	15.21
Magnesia (MgO).....	41.06	21.00
Lime (CaO).....		.10
Soda (Na <sub>2</sub> O) with a little potash (K <sub>2</sub> O).....		2.97
	100.91	101.20

From these results was calculated the mineral composition as below:

	<i>Per cent.</i>
Nickeliferous iron .....	7.00
Magnetic pyrites .....	6.10
Bronzite	} ----- 86.90
Olivine	
Albite or oligoclase	
Chrome iron	
	<hr/> 100.00

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 50, 1870, pp. 339–341.

LUTSCHAUNIG (LAMPA), ATACAMA DESERT, CHILE. No. 419.

Stone, Cg. 70-gram fragment from a mass found in 1860.

MACAO, RIO GRANDE DO NORTE, BRAZIL. No. 134.

Stone, Cia or Ci. Weight, 68.5 grams. Fell November 11, 1836, at 5 o'clock in the morning, with the usual detonations and brilliant light. The stones were first stated to fall over an area of some ten leagues radius. Very many stones fell, weighing from one-half to 40 kilograms each. Total weight not known. Wülfing accounts for but 2,902 grams. No analysis seems to have been made, nor a satisfactory mineralogical determination.

*Reference.*—O. A. Derby, Meteoritos Brasileiros, Revista do Observatorio, 1888, p. 7.

McKINNEY, COLLIN COUNTY, TEXAS. Nos. 188, 240.

Stone, Cs (?). Two pieces, weighing 66 and 1,168 grams. From a mass weighing about 100 kilograms, thought to have fallen in 1870. Fragment with reddish brown, much oxidized crust. Ground green-black, fine, and compact. Susceptible of a polish. Chondrules

abundant and of all sizes up to 7 mm. Whitfield found the stone to consist of:

	Per cent.
Troilite .....	6.26
Schreibersite .....	.58
Metal .....	5.70
Chromite .....	.11
Silicate minerals .....	87.85
	<hr/> 100.00

The silicate portion yielded:

Silica ( $\text{SiO}_2$ ) .....	43.30
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	15.18
Ferrous oxide ( $\text{FeO}$ ) .....	8.45
Lime ( $\text{CaO}$ ) .....	1.88
Magnesia ( $\text{MgO}$ ) .....	30.48
Manganous oxide ( $\text{MnO}$ ) .....	.25
Nickel oxide ( $\text{NiO}$ ) .....	.51
	<hr/> 100.05

The metallic portion yielded:

Iron (by difference) .....	85.84
Cobalt (Co) .....	.92
Copper (Cu) .....	.08
Nickel (Ni) .....	13.16
	<hr/> 100.00

Recalculated these analyses give the composition of the stone as a whole, as follows:

	Per cent.
Silica ( $\text{SiO}_2$ ) .....	87.90
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	18.29
Ferrous oxide ( $\text{FeO}$ ) .....	7.40
Lime ( $\text{CaO}$ ) .....	1.65
Magnesia ( $\text{MgO}$ ) .....	28.69
Manganous oxide ( $\text{MnO}$ ) .....	.21
Nickel oxide ( $\text{NiO}$ ) .....	.44
Iron (Fe) .....	5.07
Cobalt (Co) .....	.05
Copper (Cu) .....	.004
Nickel (Ni) .....	.92
Phosphorus (P) .....	.05
Ferrous sulphide ( $\text{FeS}$ ) .....	6.26
Chromite .....	.11
	<hr/> 100.044

*Reference.*—G. P. Merrill, Amer. Journ. Sci., vol. 35, 1913, p. 520.

MAEME, HIRUGARI, SATSUMA, JAPAN. Nos. 112, 407.

Stone, Cwa. Weight, 40.2 grams. Two fragments with crust. Fell November 10, 1886, at 3 p. m. Total original weight, 328 grams. The stone does not seem to have been analyzed or otherwise studied.

*Reference.*—Kotora Jimbo, Beitr. Min. Japan, No. 2, 1906, p. 30.

**MAGURA (ARVA), SZLANICZA, HUNGARY. Nos. 22, 219.**

Iron, Og. Two slices, weighing 98 and 102 grams, respectively. Etched showing Widmanstätten figures. Found in 1840; date of fall unknown. Original weight perhaps 30 zentners (3,000 pounds?), of which the greater part was smelted, only some two zentners (200 pounds?) being saved. Composition: Analysis by Patera (I) and Löwe (II) yielded:

Constituents.	I.	II.
	<i>Per cent.</i>	<i>Per cent.</i>
Iron (Fe).....	92.22	90.92
Nickel (Ni).....	6.76	7.32
Residue (Si and C).....	1.41	1.17
	100.39	99.41

It was the nickel-iron phosphide found in this iron to which Haidinger and Patera first gave the name schreibersite.

*Reference.*—See Wülfing, p. 211.

**MANBHOOM, BENGAL, EAST INDIA. Nos. 147, 490.**

Stone, Am. Fragments weighing 12 grams, from a shower of three stones weighing collectively 1.5 kilograms, which fell December 22, 1863. The stone is breccia-form in structure and consists of olivine, bronzite, feldspar, chromite, metallic iron, and troilite. A chemical analysis by H. B. von Foullon yielded:

	<i>Per cent.</i>
Silica (SiO <sub>2</sub> ) .....	40.12
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> ) .....	.83
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ) .....	.55
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	1.80
Ferrous oxide (FeO) .....	20.53
Manganous oxide (MnO) .....	.07
Magnesia (MgO) .....	27.30
Lime (CaO) .....	1.93
Soda (Na <sub>2</sub> O) .....	.44
Potash (K <sub>2</sub> O) .....	.20
Iron (Fe) .....	4.24
Nickel (Ni) .....	.91
Sulphur (S) .....	1.70
Phosphorus (P) .....	.20
	<hr/> 100.82

*References.*—W. Haidinger, Der Meteorstein von Manbhoom. Sitz. Akad. Wiss. Wien, vol. 50, 1864, p. 241. H. B. von Foullon, Ann. k. k. Naturhist. Hofmus., vol. 3, 1888, p. 203.

## MARION (9 MILES FROM), LINN COUNTY, IOWA. No. 461.

Stone, Cwa. Fragment about 70 by 75 mm., with crust, weighing 45 grams. Fell February 25, 1847. (See Hartford, Linn County, Iowa.)

## MARJALAHTI, FINLAND. No. 319.

Stony-iron, Pallasite. Fragment weighing 346 grams, from a mass weighing 44.8 kilograms, which fell on June 1, 1902. It has been the object of detailed investigation by L. H. Borgström, who reports it to consist of some 80 per cent by weight of nickel-iron and 20 per cent olivine. The iron yielded:

	Per cent.
Iron (Fe)-----	92.28
Nickel (Ni)-----	7.18
Cobalt (Co)-----	.42
Chromium and phosphorus (Cr and P)-----	None
	<hr/> 99.83

The olivine yielded:

	Per cent.
Silica (SiO <sub>2</sub> )-----	40.26
Ferrous oxide (FeO)-----	11.86
Magnesia (MgO)-----	47.26
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> )-----	.12
Potash (K <sub>2</sub> O)-----	.05
Soda (Na <sub>2</sub> O)-----	.04
	<hr/> 99.59

Analyses were also given of the fused crust and the kamacite-taenite-plessite compound.

*Reference.*—L. H. Borgström, Die Meteoriten von Hvittis und Marjalahti. Bull. Comm. geol. Finlande, No. 14, 1903, p. 45.

## MART, McLENNAN COUNTY, TEXAS. No. 221.

Iron, Of. Weight, 456 grams. Slice etched, showing typical Widmanstätten figures: small nodules and veins of troilite and schreibersite. Weight of original mass, 7,149 grams. Date of fall unknown. Found in 1898. Chemical composition, as determined by H. N. Stokes:

	Per cent.
Iron (Fe)-----	89.68
Nickel (Ni)-----	9.20
Cobalt (Co)-----	.83
Copper (Cu)-----	.037
Phosphorus (P)-----	.158
Sulphur (S)-----	.017
Chromite (FeOCr <sub>2</sub> O <sub>3</sub> )-----	Trace
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> )-----	Trace
	<hr/> 99.422

The mineral composition as calculated from analyses is:

	Per cent.
Nickel-iron .....	98.817
Schreibersite .....	1.06
Troilite .....	.05
Chromite .....	Trace
Secondary iron oxide ( $\text{Fe}_2\text{O}_3$ ) .....	Trace
	<hr/> 99.427

The structure is octahedral, with fine plates of taenite. In composition and structure it so closely resembles the Carlton-Hamilton iron as to lead to the suggestion by Merrill that it may belong to the same fall.

Gift of O. C. Charlton.

*Reference.*—George P. Merrill and H. N. Stokes, A new iron meteorite from Mart, Texas. Proc. Washington Acad. Sci., vol. 2, 1900, p. 41.

**MATATIELA, EAST GRIQUALAND, SOUTH AFRICA. No. 488.**

Iron, Om. A 70-gram end slice, triangular in outline, showing portion of original surface, from a mass weighing 298 kilograms (657 pounds) found about 1885. Analyses by Dr. J. Fahrenhorst yielded the results given below, No. I being the total composition and II that of the metal minus the schreibersite, troilite, and lawrencite:

Constituents.	I.	II.
	<i>Per cent.</i>	<i>Per cent.</i>
Iron (Fe).....	92.20	92.21
Nickel (Ni).....	7.30	7.03
Cobalt (Co).....	.67	.65
Copper (Cu).....	.03	.03
Chromium (Cr).....	None.	None.
Carbon (C).....	0.08	0.08
Chlorine (Cl).....	.03	.....
Phosphorus (P).....	.19	.....
Sulphur (S).....	.03	.....
	<hr/> 100.53	<hr/> 100.00

The mineral composition as calculated is:

	Per cent.
Nickel-iron .....	98.64
Iron-nickel-phosphide .....	1.23
Troilite .....	.08
Lawrencite .....	.05
	<hr/> 100.00

Specific gravity, 7.808.

Gift of South African Museum.

*Reference.*—E. Cohen, Ann. S. African Mus., vol. 2, 1900, p. 9.

**HERCEDITAS, VALPARAISO, CHILE;** also known as El Chazaralino. No. 313.

Iron, Om. Weight, 206 grams. Slice about 11 by 9 cm. by 5 mm. Etched and showing Widmanstätten figures. Date of fall unknown; found in 1884 and described in 1890. Original weight, 43.4 kilograms.

*Reference.*—E. E. Howell, Proc. Rochester Acad. Sci., vol. 1, 1890, p. 99.

**MINAS GERAES, BRAZIL. No. 109.**

Stone, Cwa. Fragment weighing 11 grams.

**MINOX, TANNEY COUNTY, MISSOURI. Nos. 123, 297, 323.**

Stony-iron, Mesosiderite. Weight, 268 grams. In three pieces, weighing 34 grams, 108 grams, and 126 grams. Shows the reticulated metallic portion holding the siliceous material consisting of olivine, bronzite, augite, and plagioclase. Date of fall uncertain. First described in 1860. Original mass weighed 89.342 kilograms (197 pounds. Analysis by Whitfield yielded:

**Metallic portion:**

	Per cent.
Iron (Fe).....	89.41
Nickel (Ni).....	10.41
Cobalt (Co).....	.29
Phosphorus (P).....	.16
	<hr/> 100.27

**Stony portion:**

Silica (SiO <sub>2</sub> ).....	45.88
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	7.89
Ferrous oxide (FeO).....	19.78
Lime (CaO).....	6.02
Magnesia (MgO).....	17.96
Nickel sulphide (NiS).....	1.67
Ferrous sulphide (FeS).....	.54
	<hr/> 99.69

**The silicate portion yielded:**

Constituents.	Insoluble portion.	Soluble portion.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica (SiO <sub>2</sub> ).....	26.95	52.39
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	17.69	7.11
Ferrous oxide (FeO).....	35.98	14.68
Lime (CaO).....	15.98	4.49
Magnesia (MgO).....	3.40	21.33
	<hr/> 100.00	<hr/> 100.00

Recalculations of these analyses give the following figures to show the composition of the entire meteorite:

	Per cent.
Silica ( $\text{SiO}_2$ )	20.64
Alumina ( $\text{Al}_2\text{O}_3$ )	3.55
Ferrous oxide ( $\text{FeO}$ )	8.88
Magnesia ( $\text{MgO}$ )	8.08
Lime ( $\text{CaO}$ )	2.71
Iron (Fe)	49.18
Nickel (Ni)	5.73
Cobalt (Co)	.16
Phosphorus (P)	.08
Iron sulphide ( $\text{FeS}$ )	.99
	100.00

Specific gravity of mass, 4.484.

This stone is doubtless identical with that of Newton County, Arkansas, described by J. Lawrence Smith in 1865. The 34-gram piece the gift of George F. Kunz.

*Reference.*—G. F. Kunz, Amer. Journ. Sci., vol. 34, 1887, p. 467. It should be noted that on page 469 of this paper Mr. Kunz made a very obvious error in tabulating the soluble silicate portion as *insoluble*, and vice versa.

**MISSHOF, COURLAND, RUSSIA. Nos. 236, 247.**

Stone, Cc. Two pieces with crust, weighing, respectively, 45 grams and 109 grams. Weight of original mass, 5,800 grams. Fell on the afternoon of April 10, 1890, at about 4 o'clock. The stone is described by Bruno Doss as an aggregate of chondrules and isolated fragments of olivine and enstatite imbedded in an ash-gray ground of a tufaceous nature. Pyrrhotite and native iron occur in small quantities. There are also present other silicate minerals, as a triclinic feldspar and a monoclinic pyroxene. The rhombic pyroxene is polysynthetically twinned. Chromite occurs in the usual small granular form. A chemical analysis by E. Johanson yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	34.96
Alumina ( $\text{Al}_2\text{O}_3$ )	.29
Chromic oxide ( $\text{Cr}_2\text{O}_3$ )	1.368
Tin oxide ( $\text{SnO}_2$ )	.156
Iron (Fe)	14.806
Nickel (Ni)	1.35
Copper (Cu)	.19
Manganese (Mn)	.276
Ferrous oxide ( $\text{FeO}$ )	11.85
Manganous oxide ( $\text{MnO}$ )	4.372
Magnesia ( $\text{MgO}$ )	19.33
Potash ( $\text{K}_2\text{O}$ )	1.13
Soda ( $\text{Na}_2\text{O}$ )	3.94
Troilite ( $\text{FeS}$ )	5.75
Pyrrhotite ( $\text{Fe}_7\text{S}_8$ )	.54
Chlorine (Cl)	.007
	100.315

The mineral composition as given is:

	Per cent.
Nickel-iron .....	17.95
Pyrrhotite .....	5.82
Silicate soluble in HCl (37 per cent olivine) .....	46.52
Silicate insoluble in HCl (mainly bronzite) .....	29.26
Chrome iron .....	.45
Soluble in water .....	.12
	<hr/>
	100.12

*Reference.*—B. Doss and E. Johanson, *Der Meteorit von Misshof. Arbeiten des Naturforscher-Vereins zu Riga, Heft. 7, 1891.*

**MISTECA, OAXACA, MEXICO. No. 459.**

Iron, Om. Slice 16 by 17 cm., weighing 1,280 grams. From a mass weighing 421 kilograms, or 927 pounds, found about 1804 and first described in 1843. An incomplete analysis by C. Bergemann yielded:

	Per cent.
Iron (Fe) .....	86.857
Nickel (Ni) .....	9.917
Cobalt (Co) .....	.745
Phosphorus (P) .....	.070
Sulphur (S) .....	.553
Insol. residue .....	.975
	<hr/>
	99.117

The insoluble residue consisted of carbon, iron, phosphorus, and nickel.

*Reference.*—C. Bergemann, *Pogg. Ann.*, vol. 100, 1857, p. 246.

**MOOS, TRANSYLVANIA, HUNGARY. Nos. 18, 467.**

Stone, Cwa. Thirty-six nearly complete individuals weighing from 7 to 86 grams. One fragment with crust, weighing 325 grams, and 19 smaller fragments, weighing 430 grams. Aggregate weight, 1,607 grams. Fell February 3, 1882, at 4 o'clock in the afternoon. This fall was one of the most remarkable on record, the number of fragments being estimated as upward of 3,000, the aggregate weight of which was from 174,113 grams to 300,000 grams, the largest known mass weighing 70,000 grams. The stones were distributed over an area of some 3 by .6 miles, according to Fletcher, or an area of 60 square kilometers, according to Koch. The chemical composition of the stone, according to Koch, is as follows:

	Per cent.
Iron (Fe)-----	7.93
Manganese (Mn)-----	.57
Nickel (Ni)-----	1.88
Cobalt (Co)-----	Trace.
Silica (SiO <sub>2</sub> )-----	42.74
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	Trace.
Ferrous oxide (FeO)-----	20.86
Manganous oxide (MnO)-----	1.12
Magnesia (MgO)-----	15.95
Lime (CaO)-----	2.78
Soda (Na <sub>2</sub> O)-----	1.20
Potash (K <sub>2</sub> O)-----	.21
Lithia (Li <sub>2</sub> O)-----	Trace.
Sulphur (S)-----	2.61
Phosphorus (P)-----	.41
Carbon (C) (?)-----	.19
Chromite-----	1.56
	<hr/> 99.51

Subtracting the sulphur and phosphorus as belonging to troilite and schreibersite,  $99.51 - 1.39 = 98.12$ : Soluble in hydrochloric acid, 52.30; insoluble in hydrochloric acid, 47.70.

According to Tschermak's description, the stone is chondritic, of a gray color, flecked with rust spots, and traversed by fine black veins. The mineral composition is olivine, enstatite, diallage, a plagioclase feldspar, chromite, pyrrhotite, metallic iron, and an amorphous black undetermined substance.

*References.*—A. Koch, *Min. pet. Mitth.*, vol. 5, 1883, p. 234. G. Tschermak, *Sitz. Akad. Wiss. Wien.*, vol. 85, 1882, p. 195.

**MODOC, SCOTT COUNTY, KANSAS. Nos. 360, 366.**

Stone, Cwa. Two complete individuals, weighing, respectively, 1,170 grams and 2,268 grams, representing the second and fourth largest stones out of a shower of 15 stones having an aggregate weight of 16 kilograms (about 35 pounds), which fell on the night of September 2, 1905, at about 10 p. m. (pl. 25, fig. 2). The fall was observed and described by Mr. J. K. Freed, to whom the United States National Museum is indebted for the two samples here recorded, and from whose account the following has been taken:

The first explosion of the meteorite is said to have occurred when it was about 6 miles due west of Scott City, and to have occasioned a terrific roar plainly heard for a distance of 25 miles, awakening those who had already gone to sleep and frightening people for miles around. Its appearance at the time of the explosion was variously described as like the "headlight of a locomotive," and as a "white light as big as a haystack afire." Eighteen miles

south of Scott City it is stated to have occasioned light enough to enable one to pick up a pin. Following the explosion there was a noise compared with the discharge of a heavy battery of artillery or of a heavy wagon running rapidly over the frozen ground, the noise gradually dying away like rolling thunder in the distance. Some claim to have heard the whistling of rocks through the air like bullets or heavy hail, while Mr. Freed himself compared the sound to that of "a mighty swish-h-h, resembling the sound of a sky rocket."

A search extending over a period of several months resulted in the finding of some 15 specimens, as noted above, scattered over an area of 2 by 7 miles in the vicinity of Modoc, a small town on the Missouri Pacific Railroad. These were mostly complete individuals, the largest of which weighed 4,640 grams. They were nearly all covered with dull brown-black crust, as shown in the specimens, showing no appreciable traces of flow structure or perceptible thickening in any part, and the surfaces as a whole are remarkably free from pittings. A broken fracture shows a gray, distinctly chondritic stone with small black veins. The mineral composition is essentially olivine and enstatite, together with metallic iron and troilite. Chondrites inconspicuous on broken surface. Chemical analyses by Wirt Tassin yielded the following results:

**Metallic portion:**

	Per cent.
Iron (Fe)-----	6.56
Nickel (Ni)-----	.68
Cobalt (Co)-----	.034
	<hr/>
	7.274

**Soluble silicate portion:**

Silica (SiO <sub>2</sub> )-----	17.38
Ferrous oxide (FeO)-----	10.95
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	.20
Lime (CaO)-----	.14
Magnesia (MgO)-----	17.73
	<hr/>
	46.40

**Insoluble silicate portion:**

Silica (SiO <sub>2</sub> )-----	28.75
Ferrous oxide (FeO)-----	4.42
Manganous oxide (MnO)-----	.10(?)
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	2.27
Lime (CaO)-----	1.60
Magnesia (MgO)-----	8.72
Potash (K <sub>2</sub> O)-----	Present, but not determinable.
Soda (Na <sub>2</sub> O)-----	.44
	<hr/>
	44.30

The mass composition, as derived from the combination of the several determinations, is:

	Per cent.
Iron (Fe) .....	6.56
Nickel (Ni) .....	.68
Cobalt (Co) .....	.084
Sulphur (S) .....	1.38
Phosphorus (P) .....	.051
Silica (SiO <sub>2</sub> ) .....	44.13
Ferrous oxide (FeO) .....	15.37
Manganous oxide (MnO) .....	.10(?)
Lime (CaO) .....	1.74
Magnesia (MgO) .....	23.45
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	2.47
Potash (K <sub>2</sub> O) .....	Trace.
Soda (Na <sub>2</sub> O) .....	.44
	<hr/> 99.40

The mineralogical composition, as calculated from the above summation, is as follows:

	Per cent.
Nickel-Iron .....	4.59
Troilite .....	3.79
Schreibersite .....	.34
Olivine .....	46.40
Estatite .....	29.94
Other insoluble silicates .....	14.36
	<hr/> 99.42

*References.*—George P. Merrill, Amer. Journ. Sci., vol. 21, 1906, p. 356. O. C. Farrington, Field Col. Mus. Pub. No. 122, Geol. Ser., vol. 3, No. 6, 1907, p. 121.

**MOLONG, NEW SOUTH WALES, AUSTRALIA. No. 516.**

Stony-iron, Pallasite. Roughly broken oxidized fragments weighing 510 grams from a recently found mass as yet undescribed.

Gift of Department of Mines, Sydney, New South Wales.

**MONROE (CABARRUS COUNTY), NORTH CAROLINA. No. 268.**

Stone, Cga. Fragment with small area of crust, weighing 49 grams, from a mass weighing originally about 8.8 kilograms, or 19½ pounds, which fell on October 31, 1849. The mineral and chemical composition as given by Merrill is as follows:

Silica (SiO <sub>2</sub> ) .....	36.71	} Silicates --- 82.60
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	3.59	
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ) .....	Trace.	
Ferrous oxide (FeO) .....	14.80	
Manganous oxide (MnO) .....	.23	
Nickel and cobalt oxides (NiOCoO) ..	.46	
Lime (CaO) .....	2.27	
Magnesia (MgO) .....	24.54	

Iron (Fe)-----	12.58	} Metal -----	13.54
Nickel (Ni) -----	.87		
Cobalt (Co)-----	.09		
Iron (Fe)-----	2.39	} Troilite-----	3.80
Sulphur (S) -----	1.41		
<hr/>			99.94

No traces of barium, strontium, lithium, soda, potash, zirconium, or copper could be discovered.

The early analysis by Shepard can scarcely be considered as satisfactory.

*References.*—C. U. Shepard, Account of three new American meteorites, with observations upon the geographical distribution of such bodies. Proc. Amer. Assoc. Adv. Sci., vol. 3, 1850, p. 147. George P. Merrill, Mem. Nat. Acad. Sci., vol. 14, 1916, p. 15.

**MOORANOPPIN, 160 MILES EAST OF YORK, WEST AUSTRALIA. No. 415.**

Iron, Ogg. Thin slice 5 by 3 cm. by 7 mm. thick; weight 73 grams.

**MOORESFOOT (TIPPERARY), IRELAND. No. 306.**

Stone, Cga or Ccb. Weight, 112 grams; fragment with crust on two sides. Fell in August, 1810. A single mass weighing 3.54 kilograms (7½ pounds). No satisfactory analysis seems to have been made.

*Reference.*—William Higgins, Philos. Mag., vol. 38, 1811, p. 262.

**MORDVINOVKA, PAVLOGRAD, EKATERINOSLAV, RUSSIA. Nos. 117, 125.**

Stone, Cw. Two fragments weighing 5 and 18 grams, respectively. Fell May 19, 1826.

**MORRISTOWN, HAMBLETON COUNTY, TENNESSEE. No. 164.**

Stony-iron, Grahamite. One piece weighing 1,621 grams. Found in 1887; date of fall unknown. Several fragments were found, weighing altogether some 16,363 grams. Structure peculiar, an uneven network of metallic iron inclosing the silicate minerals. Chemical composition, as shown by Eakins's analyses:

Nickeliferous iron:		Per cent.
Iron (Fe)-----		90.92
Nickel (Ni)-----		7.71
Cobalt (Co)-----		.80
Copper (Cu)-----		Trace.
Phosphorus (P)-----		.19
Sulphur (S)-----		.04
<hr/>		99.66

## Stony portion.

Constituents.	Soluble in HCl.			Insoluble in HCl.		
	Analys.	Calculated to 100 per cent.	Molecular ratios.	Analys.	Calculated to 100 per cent.	Molecular ratios.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Silica (SiO <sub>2</sub> ).....	16.79	45.61	0.760	31.47	50.67	0.844
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	8.33	22.62	.222	9.25	14.86	.146
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ).....				.82	1.32	.009
Ferrous oxide (FeO).....	4.88	11.73	.163	6.55	10.55	.147
Nickel oxide (NiO).....	.39	1.06	.014			
Manganous oxide (MnO).....				.47	.76	.010
Lime (CaO).....	5.19	14.09	.252	2.24	3.61	.064
Magnesia (MgO).....	1.34	3.64	.091	11.16	17.98	.449
Potash (K <sub>2</sub> O).....				.02	.03	
Soda (Na <sub>2</sub> O).....				.12	.19	.008
Phosphoric acid (P <sub>2</sub> O <sub>5</sub> ).....	.46	1.25	.009			
Sulphur (S).....	.25					
	87.63	100.00	.....	62.10	100.00	.....

Mineral composition: Nickeliferous iron, enstatite, diallage, anorthite, olivine, oldhamite, lawrencite, troilite, schreibersite. Structure crystalline, sometimes cataclastic; variable. Color dark gray.

Gift of Prof. J. M. Safford.

*References.*—L. G. Eakins, A new meteorite from Hamblen County, Tennessee. *Amer. Journ. Sci.*, vol. 46, 1893, p. 283. Geo. P. Merrill, On the composition and structure of the Hamblen County, Tennessee, meteorite. *Amer. Journ. Sci.*, vol. 4, 1896, p. 149.

## MOTECKA-NUGLA, BHURTPIR, RAJPUTANA, INDIA. No. 92.

Stone, Ck. Thin slice, weighing 3 grams, from a stone which fell December 22, 1868. Original weight not known.

## MOUNT BROWNE, NEW SOUTH WALES. No. 478.

Stone, Cc. Irregular piece some 70 by 50 by 50 mm., with crust on two sides. Broken surface gray, faintly rust-spotted. Weight 408 grams. Fell about 9.30 a. m. July 17, 1902. Original weight 25½ pounds. A fairly firm stone, but breaking easily under the hammer. Metallic grains not very evident. Silicate minerals chiefly enstatite and olivine with perhaps a little feldspar. Analyses of the soluble and insoluble portions yielded as follows:

Portions soluble in warm 5 per cent hydrochloric acid :	Per cent.
Silica ( $\text{SiO}_2$ ) .....	28.81
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ) .....	1.08
Ferrous oxide ( $\text{FeO}$ ) .....	17.09
Ferrous sulphide ( $\text{FeS}$ ) .....	14.40
Lime ( $\text{CaO}$ ) .....	.76
Magnesia ( $\text{MgO}$ ) .....	37.12
Alumina ( $\text{Al}_2\text{O}_3$ ) and undetermined .....	.79

100.00

## Portion insoluble in acid :

Silica ( $\text{SiO}_2$ ) .....	54.38
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ) .....	Absent.
Ferrous oxide ( $\text{FeO}$ ) .....	8.73
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	6.58
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ) .....	.50
Lime ( $\text{CaO}$ ) .....	3.70
Magnesia ( $\text{MgO}$ ) .....	24.16
Soda ( $\text{Na}_2\text{O}$ ) .....	1.97
Potash ( $\text{K}_2\text{O}$ ) .....	.26

100.28

## Bulk analysis as follows :

Silica ( $\text{SiO}_2$ ) .....	34.81
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	2.27
Iron ( $\text{Fe}$ ) .....	28.84
Nickel ( $\text{Ni}$ ) .....	1.78
Cobalt ( $\text{Co}$ ) .....	.26
Copper ( $\text{Cu}$ ) .....	Mere trace.
Tin ( $\text{Sn}$ ) .....	Absent.
Antimony ( $\text{Sb}$ ) .....	Absent.
Magnesia ( $\text{MgO}$ ) .....	23.35
Lime ( $\text{CaO}$ ) .....	2.24
Soda ( $\text{Na}_2\text{O}$ ) .....	1.17
Potash ( $\text{K}_2\text{O}$ ) .....	.24
Lithia ( $\text{Li}_2\text{O}$ ) .....	Absent.
Manganous oxide ( $\text{MnO}$ ) .....	Mere trace.
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ) .....	.02
Vanadium oxide ( $\text{V}_2\text{O}_5$ ) .....	Mere trace.
Titanic oxide ( $\text{TiO}_2$ ) .....	Mere trace.
Barium oxide ( $\text{BaO}$ ) .....	Absent.
Strontium oxide ( $\text{SrO}$ ) .....	Absent.
Zirconium oxide ( $\text{ZrO}_2$ ) .....	Absent.
Chlorine ( $\text{Cl}$ ) .....	Absent.
Phosphorus ( $\text{P}$ ) .....	.11
Sulphur ( $\text{S}$ ) .....	2.02
Carbon ( $\text{C}$ ) .....	.11
Oxygen ( $\text{O}$ ) by difference .....	2.78

100.00

*Reference.*—Harold P. White, Notes and analysis of the Mt. Browne meteorite. Rec. Geol. Surv. New South Wales, vol. 7, 1900–1904, p. 312.

## MOUNT DYRRING, SINGLETON DISTRICT, NEW SOUTH WALES. No. 479.

Stony-iron, Pallasite. Oxidized piece some 70 by 60 by 20 mm., polished on one side. Shows no metallic iron. Weight, 190 grams. Found in 1903 by an aboriginal at Mount Dyrring, 8 miles north of Bridgman. Original weight, 25 pounds. Mineral composition, as determined by George W. Card:

	Per cent.
Olivine .....	72.00
Nickel-iron .....	25.00
Schreibersite and troilite .....	1.00
Al <sub>2</sub> O <sub>3</sub> , Na <sub>2</sub> O, etc. ....	2.00
	<hr/> 100.00

Bulk analysis by John C. H. Mingaye yielded:

	Per cent.
Moisture at 100° C. ....	.82
Water about 100° C. ....	3.89
Silica (SiO <sub>2</sub> ) .....	25.64
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	1.32
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> ) .....	29.90
Ferrous oxide (FeO) .....	7.65
Manganous oxide (MnO) .....	<sup>1</sup> Trace.
Lime (CaO) .....	.01
Magnesia (MgO) .....	27.90
Soda (Na <sub>2</sub> O) .....	.14
Potash (K <sub>2</sub> O) .....	<sup>1</sup> Trace.
Nickel protoxide (NiO) .....	2.11
Cobalt protoxide (CoO) .....	<sup>1</sup> Trace.
Chromium sesquioxide (Cr <sub>2</sub> O <sub>3</sub> ) .....	.11
Titanic oxide (TiO <sub>2</sub> ) .....	<sup>1</sup> Trace.
Sulphur trioxide (SO <sub>3</sub> ) .....	.15
Carbon dioxide (CO <sub>2</sub> ) .....	.13
Vanadium oxide (V <sub>2</sub> O <sub>5</sub> ) .....	Absent.
Copper oxide (CuO) .....	<sup>2</sup> Trace.
Phosphoric anhydride (P <sub>2</sub> O <sub>5</sub> ) .....	.51
Chlorine (Cl) .....	.01
	<hr/> 100.29

No tin detected. Traces of gold, platinum, iridium, and palladium.

*Reference.*—J. C. H. Mingaye, *Rec. Geol. Surv. New South Wales*, vol. 7, 1900–1904, p. 305.

<sup>1</sup> Less than 0.1 per cent.

<sup>2</sup> Copper, 0.005.



**MOUNT VERNON PALLASITE, AS FOUND.**

**FOR DESCRIPTION SEE PAGE 115.**

10



POLISHED SLICE OF MOUNT VERNON PALLASITE.

FOR DESCRIPTION SEE PAGE 115.

10

**MOUNT JOY, ADAMS COUNTY, PENNSYLVANIA. Nos. 160, 213, 356.**

Iron, Hb. Several pieces weighing 135, 1,330, and 1,765 grams, from a mass weighing 383.5 kilograms, found in 1887. No record of fall. The iron contains so much lawrencite (iron protochloride) that it decomposes rapidly on exposure. An analysis by W. Tassin yielded:

	Per cent.
Iron (Fe) -----	93.80
Nickel (Ni) -----	4.81
Cobalt (Co) -----	.51
Copper (Cu) -----	.005
Phosphorus (P) -----	.19
Sulphur (S) -----	.01
	<hr/>
	99.325

Gifts of Edward E. Howell and Jacob Snyder.

*Reference.*—E. E. Howell, Amer. Journ. Sci., vol. 44, 1892, p. 415.

**MOUNT VERNON, CHRISTIAN COUNTY, KENTUCKY. No. 300.**

Stony-iron, Pallasite. Nearly complete individual, polished on one face, weighing 288 pounds, or 130.6 kilograms (pls. 27 and 28). Found many years ago but its meteoric origin not recognized until 1902. Complete analyses not available owing to the coarse nature of crystallization. Mineral composition has been estimated as follows:

	Per cent.
Olivine -----	63.15
Nickel-iron -----	33.12
Schreibersite -----	1.95
Troilite -----	.69
Chromite -----	1.00
Carbon -----	.09
Chlorine, abundant traces; not determined.	
	<hr/>
	100.00

The nickel-iron alloy approximates one-third of the mass. Etching shows it to be made up of a dark colored alloy in which are fine lines of a tin-white color (see pls. 27 and 28), which are in part oriented with and in part penetrate the mass in zigzag shapes. Bounding this is a band of bright, white iron, which varies in width from a line to a millimeter.

Examined under the glass the mass of the iron appears to be made up of minute octahedrons arranged in fine lamellæ, and considered as a unit may be defined as a granular octahedrite containing more or less troilite and schreibersite areas.

Two portions of this constituent, each weighing 10 grams, were taken for analysis, with the following results:

	Per cent.
Iron (Fe)-----	82.520
Nickel (Ni)-----	14.044
Cobalt (Co)-----	.949
Copper (Cu)-----	.104
Sulphur (S)-----	.288
Silica (SiO <sub>2</sub> )-----	.808
Aluminum (Al)-----	.410
Carbon (C)-----	.465
Phosphorus (P)-----	.890
Chlorine (Cl)-----	Trace.
	<hr/>
	99.978

The tænite occurs in very thin, brittle, tin-white lamellæ, with a specific gravity of 7 at 20.1° C., and has the following composition:

	Per cent.
Iron (Fe)-----	68.99
Nickel (Ni)-----	85.98
Cobalt (Co)-----	.10
Copper (Cu)-----	Trace.
Phosphorus (P)-----	.04
	<hr/>
	100.11

The material is strongly magnetic, but does not possess polarity.

Schreibersite occurs fairly abundantly, approximating 1.35 per cent of the mass by measurement and 1.95 per cent by analysis. It occurs bounding the olivine areas and occasionally penetrating or contained in them. The more common occurrence is, however, as blebs, veins, or filaments in the nickel-iron constituent. The mineral has a brilliant tin-white color, is strongly magnetic, possessing polarity, and in one instance was undoubtedly crystallized, but, unfortunately, the specimen was so brittle that it fell to pieces on attempting to measure it.

An analysis gave the following:

	Per cent.
Iron-----	64.990
Nickel-----	18.905
Cobalt-----	.105
Phosphorus-----	15.700
Copper-----	Trace.
	<hr/>
	99.700

Troilite occurs commonly associated with the black specular material lining the cavities containing the olivine in the nickel-iron constituent. It varies in its dimensions from a coating a line in thickness to masses 2 or more millimeters thick by 10 millimeters in length. Grains and flakes of troilite are occasionally contained in masses of

the nickel-iron alloy and may then be associated with schreibersite areas. Further, it may occur as isolated grains or flakes and filling cracks in the olivine areas.

The material analyzed was obtained by treating the metallic portion with mercury bichloride, and after its solution separating the troilite and schreibersite from carbon, silicates, etc., with the magnet and from each other by lixiviation. The material thus obtained had a specific gravity of 4.759 at 18° C. and the following composition:

	Per cent.
Iron .....	62.99
Nickel .....	} .79
Cobalt .....	
Phosphorus .....	Trace.
Sulphur .....	36.35
	100.13

The specular material lining the olivine cavities is essentially a graphitic iron containing sulphur and chlorine. The material analyzed was far from being homogeneous, as it was separated mechanically with the aid of a glass. The composition was as follows:

	Per cent.
Iron .....	84.900
Nickel .....	} 5.039
Cobalt .....	
Silica .....	2.990
Carbon .....	2.810
Sulphur .....	1.750
Phosphorus .....	1.470
Chlorine .....	.100
Alumina .....	.940
	99.999

Chromite occurs quite abundantly, varying in size from microscopic grains to a crystal 1 millimeter in diameter. The crystals are more or less perfect octahedrons, rarely modified by other forms, and then only by  $\infty 0 (110)$ , as noted in one instance. They are brilliant black in color, with a metallic luster; nonmagnetic; have a specific gravity of 4.49 at 18° C., with the following composition:

	Per cent.
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ) .....	64.91
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	9.85
Magnesia ( $\text{MgO}$ ) .....	4.96
Ferrous oxide ( $\text{FeO}$ ) .....	17.97
Silica ( $\text{SiO}_2$ ) .....	1.38
	99.07

Olivine occurs in more or less rounded masses which, when carefully extracted, show well-marked facets. These are probably not

to be referred to any crystal forms, since no zonal relations could be established after repeated measurements. The mineral is commonly brownish in color and only occasionally honey yellow. The blebs are more or less cracked and the cracks filled with foreign material, as graphitic iron, limonite, chromite, etc. Some of the clearest grains, which under the glass were quite free from impurities, were selected for analysis, with the following results:

	Per cent.
Silica ( $\text{SiO}_2$ )	35.70
Magnesia ( $\text{MgO}$ )	42.02
Ferrous oxide ( $\text{FeO}$ )	20.79
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	.18
Alumina ( $\text{Al}_2\text{O}_3$ )	.42
Manganese (Mn)	.14
Nickel oxide ( $\text{NiO}$ )	.21
Phosphorus (P)	Trace.
	<hr/> 99.46

*Reference.*—W. Tassin, Proc. U. S. Nat. Mus., vol. 28, 1905, p. 218.

**MUONIONALUSTA, NORTHERN SWEDEN. No. 424.**

Iron, Og. Slice weighing 107 grams, from a mass weighing 7.53 kilograms found in 1906. Analysis by R. Mauzelius yielded:

	Per cent.
Iron (Fe)	91.10
Nickel (Ni)	8.02
Cobalt (Co)	.69
Copper (Cu)	.01
Chromium (Cr)	.01
Phosphorus (P)	.05
Carbon (C) and sulphur (S)	Not determined.
	<hr/> 99.88

Nickel-iron was estimated to form 99 per cent of the mass, and troilite and daubreelite 0.2 per cent.

Gift of Geological Museum of Upsala, Sweden.

*Reference.*—A. G. Högbom, Bull. Geol. Inst. Univ. Upsala, vol. 9, 1908-9, p. 229.

**MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE. No. 99.**

Iron, Om. Slice, 3.2 by 2 cm. Weight, 57.5 grams. From a mass weighing 8.5 kilograms or 18.7 pounds. Described in 1848. An imperfect analysis by G. Troost yielded:

	Per cent.
Iron	96.00
Nickel	2.40
Insoluble residue	1.60
	<hr/> 100.00

The nickel percentage is low and perhaps due to error in analysis.

*Reference.*—G. Troost, Amer. Journ. Sci., vol. 5, 1848, p. 351.

## NAGAYA, NEAR CONCEPCION, ENTRE RIOS, ARGENTINA. No. 143.

Stone, C. Three and one-half grams, from a stone which fell July 1, 1879.

## NANJEMOY, CHARLES COUNTY, MARYLAND. No. 277.

Stone, Cc. Thirteen-gram fragment from the interior of a stone stated to have weighed 16.7 ounces, which fell on February 10, 1825.

## NEJED (WADEE BANEE KHALED), CENTRAL ARABIA. No. 241.

Iron, Om. Slice, 9 by 6 cm., weighing 309 grams, from a mass, weighing 59.4 kilograms, found in 1887 and believed to have been seen to fall in 1863. Analysis yielded:

	Per cent.
Iron (Fe) -----	91.04
Nickel (Ni) -----	7.40
Cobalt (Co) -----	.66
Phosphorus (P) -----	.10
Sulphur (S) and copper (Cu) -----	Trace.
Residue -----	.59
	<hr/> 99.79

The residue consisted of carbon and chromite.

*Reference.*—L. Fletcher, *Min. Mag.*, vol. 7, 1887, p. 179.

## NELSON COUNTY, KENTUCKY. No. 54.

Iron, Ogg. Two pieces weighing 215 grams and 370 grams, from a mass weighing 73 kilograms, or 161 pounds, found in 1856. The composition, as determined by J. Lawrence Smith, is:

	Per cent.
Iron (Fe) -----	93.10
Nickel (Ni) -----	6.11
Cobalt (Co) -----	.41
Phosphorus (P) -----	.05
Copper (Cu) -----	Trace.
	<hr/> 99.67

Gift of J. Berrien Lindsley.

*Reference.*—J. L. Smith, *Original Researches in Mineralogy and Chemistry*, 1884, p. 409. Originally published in *Amer. Journ. Sci.*, vol. 30, 1860, p. 240.

## NESS COUNTY, KANSAS. Nos. 226, 227, 250, 259, 260.

Stone, Cib. Twelve nearly complete individuals weighing respectively, 29, 48, 63, 70, 99, 103, 108, 138, 191, 206, 264, 833 grams. From a fall of unknown date, the first example of which was found in 1898.

The total weight of all the known material is nearly 10 kilograms. Analysis by J. E. Whitfield yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	38.340
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	8.551
Alumina ( $\text{Al}_2\text{O}_3$ )	8.259
Chromic oxide ( $\text{Cr}_2\text{O}_3$ )	.587
Lime ( $\text{CaO}$ )	1.180
Magnesia ( $\text{MgO}$ )	24.040
Loss on ignition	3.500
Iron ( $\text{Fe}$ )	13.860
Nickel ( $\text{Ni}$ )	1.050
Cobalt ( $\text{Co}$ )	.030
Copper ( $\text{Cu}$ )	.050
	99.447

*References.*—G. P. Merrill, *Amer. Journ. Sci.*, vol. 35, 1913, p. 517.  
H. A. Ward, *Amer. Journ. Sci.*, vol. 7, 1899, p. 233.

**NETSHAËVO, GOVERNMENT OF TULA, RUSSIA. No. 404.**

Stony-iron, Mesosiderite. A fragment, weighing 13 grams, from a 250-kilogram mass found in 1846. This fragment represents the silicate portion of a mass composed largely of metal, and classed by Brezina as an octahedral iron with crystalline chondrites. It may best be described as an iron with included fragments of silicate minerals in pieces up to a walnut in size. Auerbach's analyses showed it to consist of 72.98 olivine, 16.70 metal, 10.21 plagioclase and augite, 0.11 chromite, and traces of iron sulphide.

*Reference.*—H. Laspeyres, *Zeitschr. Kryst. Min.*, vol. 24, 1895, p. 495.

**NEW CONCORD, MUSKINGUM COUNTY, AND GUERNSEY COUNTY, OHIO. Nos. 2, 62, 324, 339, 367.**

Stone, Cia. Three broken masses and two complete individuals, weighing 21, 196, 554, 1,720, and 2,841 grams. From a fall on May 1, 1860, comprising over 30 stones, the largest of which weighed 209 kilograms (460½ pounds), and the aggregate weight of which was 350 kilograms (770 pounds).

This is one of the most remarkable and interesting of American falls, not merely on account of the size and number of the stones, but because of the large number of witnesses and consequently the amount of reliable data concerning it. It is well to note that though some of the stones were gathered up immediately they were not warmer than though they had been lying in the sun, and a 51-pound mass buried itself in the ground to a depth of but about 2 feet. As determined by J. Lawrence Smith, the mineral composition is:

	Per cent.
Nickel-iron .....	10.690
Schreibersite .....	.005
Magnetic pyrites .....	.005
Olivine .....	56.884
Pyroxene .....	82.416
	<hr/> 100.000

The chemical composition as determined by the same authority is:

	Per cent.
Silica ( $\text{SiO}_2$ ) .....	41.73
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	.23
Ferrous oxide ( $\text{FeO}$ ) .....	24.72
Magnesia ( $\text{MgO}$ ) .....	21.64
Lime ( $\text{CaO}$ ) .....	.02
Soda ( $\text{Na}_2\text{O}$ ) --- } .....	.92
Potash ( $\text{K}_2\text{O}$ ) --- } .....	
Iron ( $\text{Fe}$ ) .....	9.23
Nickel ( $\text{Ni}$ ) .....	1.31
Cobalt ( $\text{Co}$ ) .....	.04
Sulphur ( $\text{S}$ ) .....	.11
Manganese ( $\text{Mn}$ ) .....	Trace
	<hr/> 100.00

In part, gifts of E. B. Andrews (No. 2), Jas. Greer (No. 324), and J. B. Lindsley (No. 62).

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 31, 1861, p. 87.

**HOWO-UREI, KRASNOSLOBODEK, PENSA, RUSSIA. No. 307.**

Stone, Cu. Weight, 83 grams. Fragment with crust; fell September 22, 1886. Three stones fell, one of which was not recovered, having fallen in a marsh; a second passed into the hands of a countryman, and its weight not determined. The third, which passed into the possession of the mineral cabinet of the Institute of Forestry, St. Petersburg, weighed 1.9 kilos. The stone contains carbon in both the amorphous form and that of microscopic diamond, and is therefore of unusual interest.

A bulk or mass analysis yielded:

	Per cent.
Iron ( $\text{Fe}$ ) .....	5.25
Nickel ( $\text{Ni}$ ) .....	.20
Ferrous oxide ( $\text{FeO}$ ) .....	13.35
Manganous oxide ( $\text{MnO}$ ) .....	.43
Alumina ( $\text{Al}_2\text{O}_3$ ) .....	.60
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ) .....	.95
Magnesia ( $\text{MgO}$ ) .....	35.80
Lime ( $\text{CaO}$ ) .....	1.40
Sulphur ( $\text{S}$ ) .....	.15
Phosphorus ( $\text{P}$ ) .....	.02
Silica ( $\text{SiO}_2$ ) .....	39.51
Carbon ( $\text{C}$ ) { amorphous .....	1.26
{ as diamond .....	1.00
	<hr/> 99.92

The chemical composition of the individual constituents is given as follows:

Constituents.	Olivine.	Augite.	Total.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Magnesia (MgO).....	28.35	7.42	35.77
Lime (CaO).....	.86	.55	1.41
Ferrous iron (FeO).....	11.38	1.70	13.08
Manganous oxide (MnO).....	.34	.09	.43
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....		.60	.60
Silica (SiO <sub>2</sub> ).....	26.43	13.21	39.67
Total silicate portion.....	67.36	23.57	90.96
Nickel-iron (NiO, 20%).....			5.47
Iron sulphide.....			.43
Chromic iron.....			.65
Amorphous carbon.....			1.26
Diamonds.....			1.00
			99.77

*Reference.*—M. Jerofeieff and P. Latschinoff, *Der Meteorit von Nowo-Urei*. Verh. russ.-kais. Min. Ges., vol. 24, 1888, p. 263.

**OAKLEY, LOGAN COUNTY, KANSAS. No. 943.**

Stone, Cka. Weight 320 grams; date of fall unknown; found in 1895 at a depth of about 1 meter below the surface. Original weight 61 pounds 10 ounces (28 kilograms). Mechanical analysis showed it to consist of:

	<i>Per cent.</i>
Iron (Fe).....	12.76
Nickel (Ni) and Cobalt (Co).....	1.68
Silicates.....	85.56
	100.00

J. M. Davison found the metallic portion to consist of:

	<i>Per cent.</i>
Iron (Fe).....	89.16
Nickel (Ni).....	10.84
	100.00

The structure is described as chondritic, closely resembling that of Pipe Creek, Bandera County, Texas. The mineral composition is olivine, enstatite, pyrrhotite, and metallic iron, with possibly a lime-soda feldspar.

*Reference.*—H. L. Preston, On a new meteorite from Oakley, Logan County, Kansas, with notes on microscopic structure by G. P. Merrill. *Amer. Journ. Sci.*, vol. 9, 1900, p. 410.

**OBERNKIRCHEN, SCHAUMBURG-LIPPE, GERMANY. No. 87.**

Iron, Of. Slice, weighing 152 grams, from a mass weighing 41 kilograms found in 1863. Date of fall unknown. Chemical analysis by Fahrenhorst yielded:

	Per cent.
Iron (Fe)-----	92.45
Nickel (Ni)-----	7.55
Cobalt (Co)-----	.83
Copper (Cu)-----	.02
Chromium (Cr)-----	.01
Sulphur (S)-----	.01
Phosphorus (P)-----	.12
Chlorine (Cl)-----	.02
	<hr/> 101.01

The mineral composition, as calculated from the analysis, is:

	Per cent.
Nickel-iron-----	99.16
Schreibersite-----	.77
Lawrencite-----	.05
Troilite-----	.02
	<hr/> 100.00

*Reference.*—E. Cohen, *Meteoritenkunde*, pt. 3, 1905, p. 363.

**OCHANSK (TABORG), PERM, RUSSIA. No. 116.**

Stone, Ccb. Two fragments, weighing 19 and 142 grams, from a shower which fell on August 30, 1887. Aggregate weight of fall uncertain. Known weight, 169,203 grams. The stone has not been analyzed as a whole, but is of interest in that it has been stated to carry the iron sulphide in the form of crystallized pyrite. The correctness of this identification has, however, been questioned.

*Reference.*—Julian v. Siemaschko, *Tschermak's Min pet. Mitth.*, vol. 11, 1890, p. 87.

**OESSEL, LIVONIA, RUSSIA. No. 178.**

Stone, Cw. Fragment with crust, weighing 13 grams, from a shower comprising some 6 kilograms which fell on May 11, 1855.

**ORANGE RIVER, SOUTH AFRICA. No. 79.**

Iron, Om. Irregular fragment 4 by 5 by 1 cm., weighing 99 grams, from a mass weighing 148½ kilograms, first known in 1855; described in 1856.

ORGUEIL, MONTAUBAN, TARN-ET-GARONNE, FRANCE. Nos. 224, 225.

Stone, K. Weights, 61 and 98 grams. Fragment with crust and nearly complete individual. Fell on the evening of May 14, 1864, a few minutes after 8 o'clock, the fall being accompanied by the usual phenomena. Over 20 stones fell, weighing in the aggregate some 11,523 grams.

This is one of the most interesting of carbonaceous meteorites, but perfectly satisfactory analyses are lacking. The stone is described as a black, porous, friable mass, falling to pieces in water. Cloez found it to contain 21.33 per cent water and organic matter. The mineral composition as calculated from his analysis would be, exclusive of the organic matter: Nickel-iron, 17.58; pyrrhotite, 11.62; chromite 0.35; and mixed silicates, 41.91. In detail his results are as follows on material dried at 110° C, the loss under this treatment being 5.975:

	Per cent.
Silica ( $\text{SiO}_2$ )	26.031
Sulphuric acid ( $\text{SO}_3$ )	2.3345
Sulphur (S)	4.6466
Chlorine (Cl)	.0776
Phosphorus (P)	Traces.
Alumina ( $\text{Al}_2\text{O}_3$ )	1.2488
Chromic oxide ( $\text{Cr}_2\text{O}_3$ )	.2392
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	14.2360
Ferrous oxide ( $\text{FeO}$ )	19.0630
Nickel oxide ( $\text{NiO}$ )	2.6057
Cobalt oxide ( $\text{CoO}$ )	.0904
Manganous oxide ( $\text{MnO}$ )	1.9302
Lime ( $\text{CaO}$ )	2.322
Magnesia ( $\text{MgO}$ )	8.6711
Soda ( $\text{Na}_2\text{O}$ )	1.323
Potash ( $\text{K}_2\text{O}$ )	.3265
Ammonia ( $\text{NH}_4\text{OH}$ )	.1042
Humic substance	6.41
Combined water	7.812

99.4728

M. Pisani gives results as follows (the material likewise dried at 110° C.):

	Per cent.
Silica ( $\text{SiO}_2$ )	26.08
Magnesia ( $\text{MgO}$ )	17.00
Protoxide of iron ( $\text{FeO}$ )	7.78
Lime ( $\text{CaO}$ )	1.85
Soda ( $\text{Na}_2\text{O}$ )	2.28
Potash ( $\text{K}_2\text{O}$ )	.19
Oxide of manganese	.36
Alumina ( $\text{Al}_2\text{O}_3$ )	.90
Chrome-iron	.49
Magnetite	15.77
Sulphide of iron	13.43
Water and supposed organic matter	13.89
	100.00

According to Des Cloizeaux the stone contains small crystals of a carbonate of magnesia and iron corresponding to the formula  $(\text{Mg Fe}) \text{CO}_3$ , which is that of the mineral breunnerite. The exact character of the carbonaceous material is still in doubt. Cloez regarded it as a humus compound. This J. Lawrence Smith was disposed to doubt, but thought it more nearly allied to the so-called hydrated carbon obtained by Schutzenbergen and Bourgeois from white cast iron.

*References.*—M. Cloez, *Compt. Rend.*, vol. 58, 1864, pp. 986–988, and vol. 59, 1864, p. 37. M. Pisani, *Compt. Rend.*, vol. 59, 1864, p. 132. J. L. Smith, *Original Researches in Mineralogy and Chemistry*, 1884, p. 506.

ORVINIO, UMBRIA, ITALY. No. 308.

Stone, Co. Fragment weighing 53 grams. Fell about 5.15 on the morning of August 31, 1872. Six stones found, weighing respectively 4.75, 92, 432, 622, 1,003, and 1,242.5 grams—a total of 3,396 grams. The stone is remarkable in consisting of rounded pebble-like masses embedded in a dense paste or ground of essentially the same composition, as shown by the analyses given below, column I being that of the pebbles and column II that of the groundmass:

Constituents.	I.	II.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica ( $\text{SiO}_2$ ).....	38.01	36.83
Alumina ( $\text{Al}_2\text{O}_3$ ).....	2.22	2.31
Iron oxide ( $\text{FeO}$ ).....	6.55	9.41
Magnesia ( $\text{MgO}$ ).....	24.11	21.69
Lime ( $\text{CaO}$ ).....	2.33	2.31
Soda ( $\text{Na}_2\text{O}$ ).....	1.46	.96
Potash ( $\text{K}_2\text{O}$ ).....	.31	.26
Sulphur (S).....	1.94	2.04
Iron (Fe).....	22.34	22.11
Nickel (Ni).....	2.15	3.04
	101.42	100.95

Specific gravity of pebbles 3.675 and of groundmass 3.60. The mineral composition as determined from these analyses by L. Sipöcz is as below:

Constituents.	I.	II.
	<i>Per cent.</i>	<i>Per cent.</i>
Metallic iron.....	18.54	18.94
Metallic nickel.....	3.04	2.15
Metallic cobalt.....	Trace.	Trace.
Iron sulphide.....	5.61	5.34
Silicate.....	77.76	74.99
Chromite.....	Trace.	Trace.
	104.95	101.42

*Reference.*—G. Tschermak, Sitz. Akad. Wiss. Wien, vol. 70, 1874, p. 459.

**OSCURO MOUNTAIN, NEW MEXICO. No. 214.**

Iron. Og. Weight, 243.7 grams; in two pieces, weighing 140.2 grams and 103.5 grams, respectively, with original and etched surfaces. Date of fall unknown. Found December, 1895. Originally three pieces, weighing  $3\frac{1}{2}$ ,  $3\frac{1}{4}$ , and  $1\frac{1}{2}$  pounds, or, altogether,  $8\frac{1}{4}$  pounds (3.7 kilograms). Composition as given by R. C. Hills:

	Per cent.
Iron (Fe)-----	90.79
Nickel (Ni)-----	7.66
Cobalt (Co)-----	.57
Phosphorus (P)-----	.27
Carbon (C) (graphite)-----	.07
	<hr/>
	99.36

*Reference.*—R. C. Hills, Proc. Colo. Sci. Soc., vol. 6, 1897, pp. 30-33.

**PACULA, JACALA, HIDALGO, MEXICO. No. 242.**

Stone, Cwb. Weight, 23 grams. Fell July 18, 1881. Three pieces found, weighing in the aggregate 3,361 grams. Light ash-gray groundmass, flecked with rust spots. Indistinctly veined.

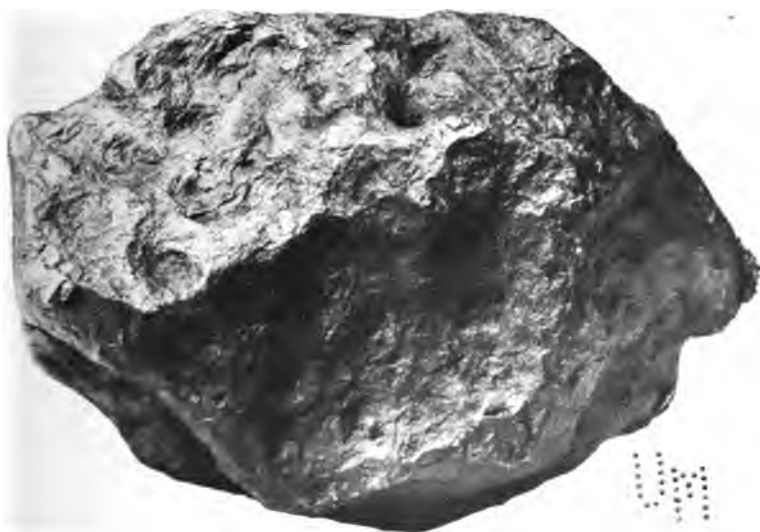
**PARNALLEE, NEAR MADURA, MADRAS, INDIA. No. 2.**

Stone, Cga. Fragment with crust, weighing 87 grams, from one of two stones weighing together 74 kilograms (163 pounds), which fell February 28, 1858, 12 m. This meteorite has been widely distributed and made the subject of much research, though the chemical analysis given below can not be considered exhaustive. Meunier has recognized in it fragments thought to represent seven different types of meteoric stones. Chemical analysis by E. von Pfeiffer yielded:

	Per cent.
Silica (SiO <sub>2</sub> )-----	89.48
Alumina (Al <sub>2</sub> O <sub>3</sub> )-----	2.58
Ferrous oxide (FeO)-----	15.28
Magnesia (MgO)-----	22.82
Lime (CaO)-----	.56
Soda (Na <sub>2</sub> O)-----	1.91
Potash (K <sub>2</sub> O)-----	.55
Iron (Fe)-----	9.83
Nickel (Ni)-----	.90
Cobalt (Co)-----	.06
Sulphur (S)-----	2.71
Phosphorus (P)-----	.10
Manganous oxide (MnO)-----	.54
Nickel oxide (NiO)-----	.72
Cobalt oxide (CoO)-----	.06
	<hr/>
	98.10



1

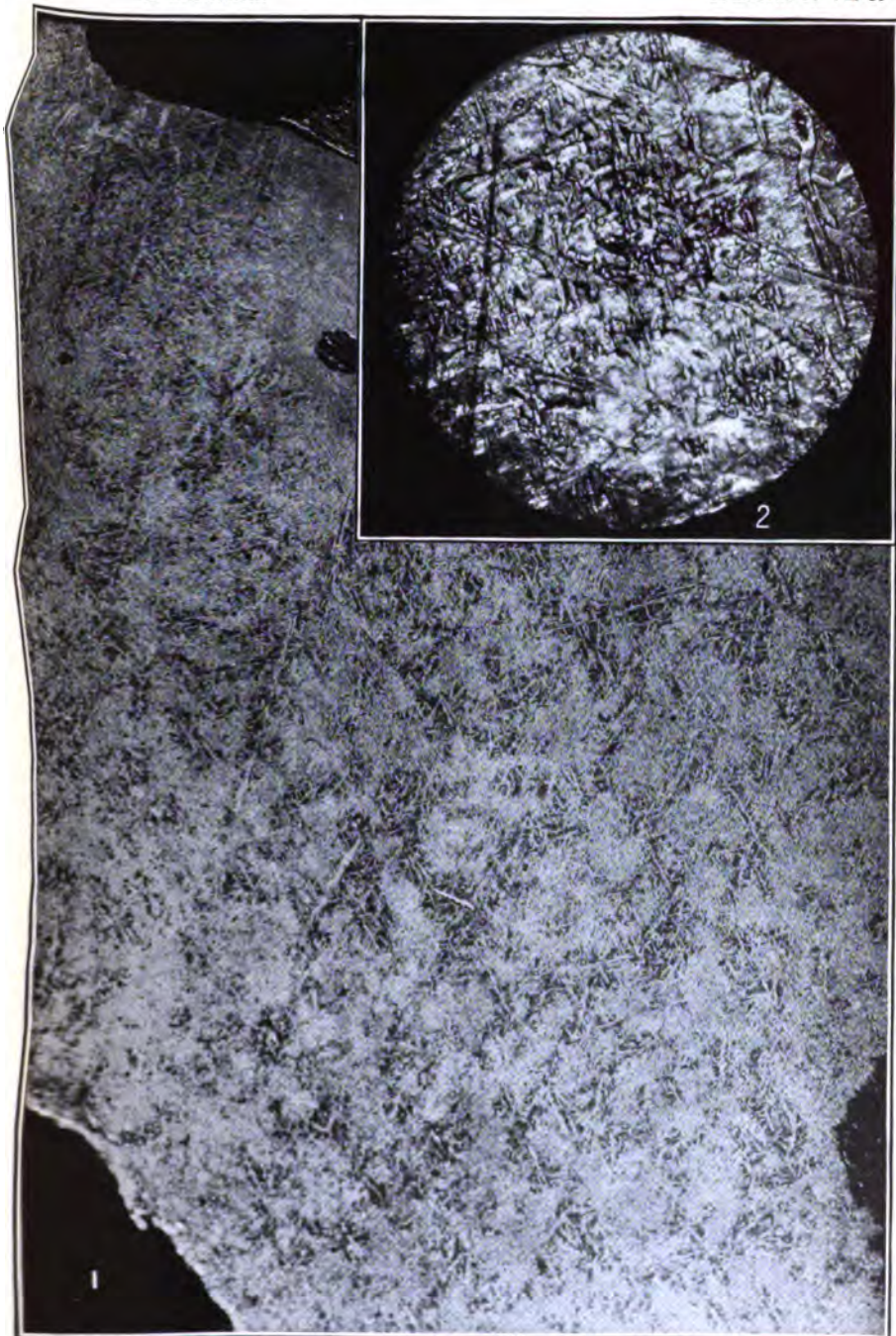


2

FRONT AND REVERSE OF PERRYVILLE IRON, AS FOUND.

FOR DESCRIPTION SEE PAGE 127.





ETCHED SURFACES OF PERRYVILLE IRON.

FOR DESCRIPTION SEE PAGE 127.





Gift of C. A. Young.

*Reference*.—E. von Pfeiffer, Sitz. Akad. Wiss. Wien, vol. 47, 1863, p. 460.

**PERRYVILLE, PERRY COUNTY, MISSOURI. No. 428.**

Iron, Off. Nearly complete individual weighing when received 17.386 kilograms, or about 38½ pounds. (Pls. 29 and 30.) Two surfaces etched. Original weight estimated to have been 17.5 kilograms. Found August, 1906. Date of fall unknown. The iron is noted for its extreme, fine crystallization. Analysis by Whitfield yielded results as below:

	Per cent.
Iron (Fe).....	89.015
Nickel (Ni).....	9.680
Cobalt (Co).....	.545
Copper (Cu).....	.025
Manganese (Mn).....	None.
Phosphorus (P).....	.365
Sulphur (S).....	.002
Silicon (Si).....	.003
Carbon (C).....	.015
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> ).....	.370
Iridium.....	} Traces.
Palladium.....	
Platinum.....	
Ruthenium.....	
	100.00

Specific gravity, 7.61.

This iron is of interest on account of the careful search made for the rarer elements, of which iridium, palladium, platinum, and ruthenium were found in traces, the last named being reported for the first time. The schreibersite separated out in process of analysis yielded:

	Per cent.
Phosphorus (P).....	14.00
Iron (Fe).....	51.10
Nickel (Ni).....	34.13
Cobalt (Co).....	.30
	99.53

*Reference*.—G. P. Merrill, Proc. U. S. Nat. Mus., vol. 43, 1912, pp. 595–597.

**PERSIMMON CREEK, CHEROKEE COUNTY, NORTH CAROLINA. No. 318.**

Iron, Offb. Nearly complete mass, one surface polished, weighing 8 pounds 3 ounces. Original weight as found in 1893, 11 pounds 3 ounces, or a trifle over 5 kilograms (pl. 31). Nothing known as to date of fall. A brecciated mass of variously oriented fragments of

octahedral iron and iron phosphide, cemented by iron sulphide, with interstitial carbon and silicates.

*References.*—W. Tassin, Proc. U. S. Nat. Mus., vol. 27, 1904, p. 955. C. Klein, Sitz. preuss. Akad. Wiss., vol. 16, 1904, p. 572.

**PETERSBURG, LINCOLN COUNTY, TENNESSEE. No. 433.**

Stone, Ho. A ten-gram fragment with crust, from a stone weighing 1,764 grams which fell August 5, 1855.

**PIPE CREEK, BANDERA COUNTY, TEXAS. No. 305.**

Stone, Cka. Weight, 168 grams. A polished section showing brown-black compact groundmass indistinctly chondritic; date of fall unknown; found December, 1887. Weight of original mass 13.5 kilograms. Partial analyses by Ledoux yielded:

	Per cent.
Metallic portion .....	30.89
Silicate portion .....	69.11
	<hr/> 100.00

The metallic portion yielded:

	Per cent.
Iron (Fe) .....	90.94
Nickel (Ni) .....	9.00
	<hr/> 99.94

The mineral composition, so far as determined, is olivine, enstatite, pyrrhotite, and iron.

*Reference.*—A. R. Ledoux, Trans. New York Acad. Sci., vol. 8, 1888-89, p. 186.

**PLYMOUTH, MARSHALL COUNTY, INDIANA. No. 393.**

Iron, Om. Weight, 182 grams. Polished slab 5.5 by 5.5 by 0.7 cm. Date of fall unknown. Found 1893 (1883?). Original weight not given. Size, 12½ inches long by 7 inches thick. A larger mass found in same locality in 1872 was buried and has not since been found. Analysis by J. M. Davison yielded:

	Per cent.
Iron (Fe) .....	88.67
Nickel (Ni) .....	8.55
Cobalt (Co) .....	.66
Copper (Cu) .....	.24
Phosphorus (P) .....	1.25
Graphite (C) .....	.11
Sulphur (S) .....	.07
	<hr/> 99.55

*Reference.*—H. A. Ward, Amer. Journ. Sci., vol. 49, 1895, p. 53.

## PRICETOWN, HIGHLAND COUNTY, OHIO. No. 199.

Stone, Cw. Two and one-half gram fragment with dull, papillated, and blebby crust, found February 13, 1893. Gift of F. W. Clarke.

## FULTUSK (BETWEEN FULTUSK AND OSTROLENKA), ON THE NAREW, POLAND, RUSSIA. Nos. 17, 463.

Stone, Cg. Four complete individuals, weighing 12, 25, 43, and 158 grams, with dull black papillated and somewhat pitted crust, and over 100 smaller forms broken and showing portion of interior, weighing, in the aggregate, upward of 1,000 grams. Fell January 30, 1868, at 7 p. m. The fall is one of the most remarkable on record, on account of the extraordinary number of stones, estimated as some 100,000, varying in weight from 7 kilograms to 1 gram. Of this material, some 200,932 grams are represented in the various collections of the world. Chemical analyses by vom Rath are not all that could be desired, owing to incomplete separations of the metallic and silicate portions. The results given are as follows:

Constituents.	Nickel iron.	Constituents.	Nonmagnetic portion.
	<i>Per cent.</i>		<i>Per cent.</i>
Sulphur (S).....	0.20	Chromite ( $\text{Cr}_2\text{O}_3, \text{FeO}$ ).....	0.34
Phosphorus (P).....	Trace.	Sulphur (S).....	2.14
Iron (Fe).....	86.84	Iron (Fe).....	3.29
Nickel (Ni).....	6.44	Silica ( $\text{SiO}_2$ ).....	46.17
Magnesia ( $\text{MgO}$ ).....	1.61	Alumina ( $\text{Al}_2\text{O}_3$ ).....	1.20
Insoluble.....	2.40	Magnesia ( $\text{MgO}$ ).....	29.53
		Lime ( $\text{CaO}$ ).....	.31
		Ferrous oxide ( $\text{FeO}$ ).....	15.25
		Manganese (Mn).....	.54
		Soda ( $\text{Na}_2\text{O}$ ).....	1.46
	98.49		100.23

The silicate analyses yielded:

Constituents.	47.16 % soluble.	52.84 % insoluble.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica ( $\text{SiO}_2$ ).....	32.5	60.01
Alumina ( $\text{Al}_2\text{O}_3$ ).....	.6	1.7
Lime ( $\text{CaO}$ ).....	.0	.6
Magnesia ( $\text{MgO}$ ).....	35.8	24.8
Iron and manganese oxides.....	22.8	10.00
Soda ( $\text{Na}_2\text{O}$ ).....		2.8
Sulphur (S).....	3.1	
Iron (Fe).....	4.8	
	90.6	90.91

Wadsworth describes the stone as consisting of a light-gray chondritic mass containing grains of iron and pyrrhotite in a ground-mass composed of olivine, enstatite, and some diallage.

*References.*—G. vom Rath, *Festschrift d. Niederrhein. Ges. Nat.-u. Heilkunde zum 50 jähr. Jubiläum der Univers. Bonn*, 1868. *Review Neues Jahrb. Min., Geol. Pal.*, 1869, p. 80. M. E. Wadsworth, *Lithological Studies*, 1884, p. 94.

FUQUIOS, CHILE. No. 153.

Iron, Om. Two slices, weighing 10.3 and 17.7 grams, respectively, from a mass weighing 6½ kilograms, found in 1885. Gift of Ward and Howell.

POTNAM COUNTY, GEORGIA. Nos. 51, 264.

Iron, Of. Found in 1839; date of fall unknown. Two pieces; one of 328 grams, somewhat oxidized, but showing cleavage plates separated by taenite, and one 10 cm. by 19 cm. by 25 cm., weighing 2,455 grams, with one face etched, showing small troilite nodule and a cleavage octahedron on one side (pl. 31). Composition, as shown by analyses of R. Knauer and O. Bürger, as follows:

	Per cent.
Iron (Fe) .....	90.28
Nickel (Ni) .....	7.89
Cobalt (Co) .....	.79
Copper (Cu) .....	.07
Chromium (Cr) .....	.17
Sulphur (S) .....	.25
Phosphorus (P) .....	.11
	<hr/> 99.56

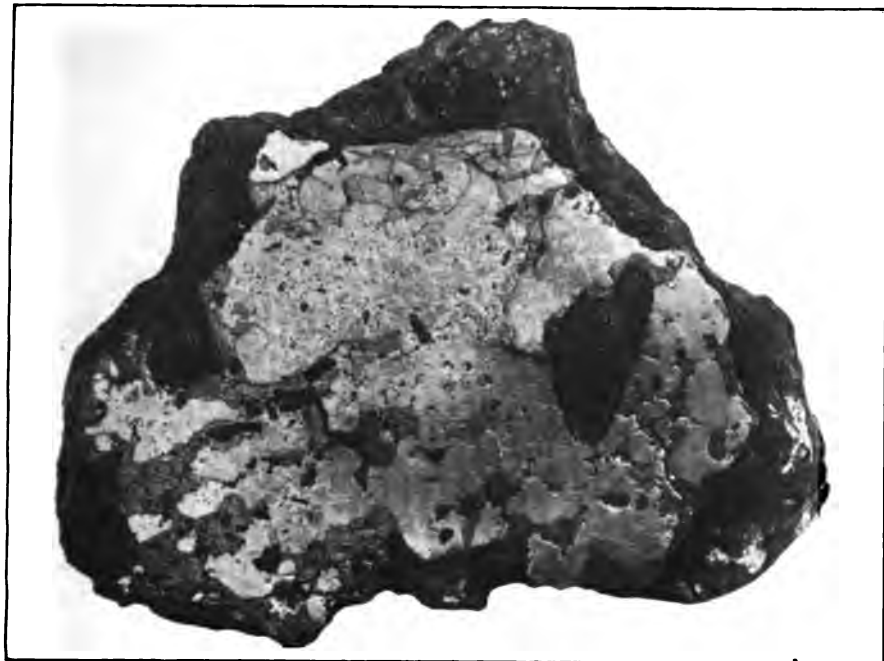
Considering the chromium as a constituent of the mineral daubreeite, the following is given as the probable mineral composition of the mass: Nickel-iron, 98.69; schreibersite, 0.73; daubreeite, 0.47; troilite, 0.11.

*References.*—J. E. Willet, *Amer. Journ. Sci.*, vol. 17, 1854, p. 331. E. Cohen, *Meteoritenkunde*, pt. 3, 1905, p. 345.

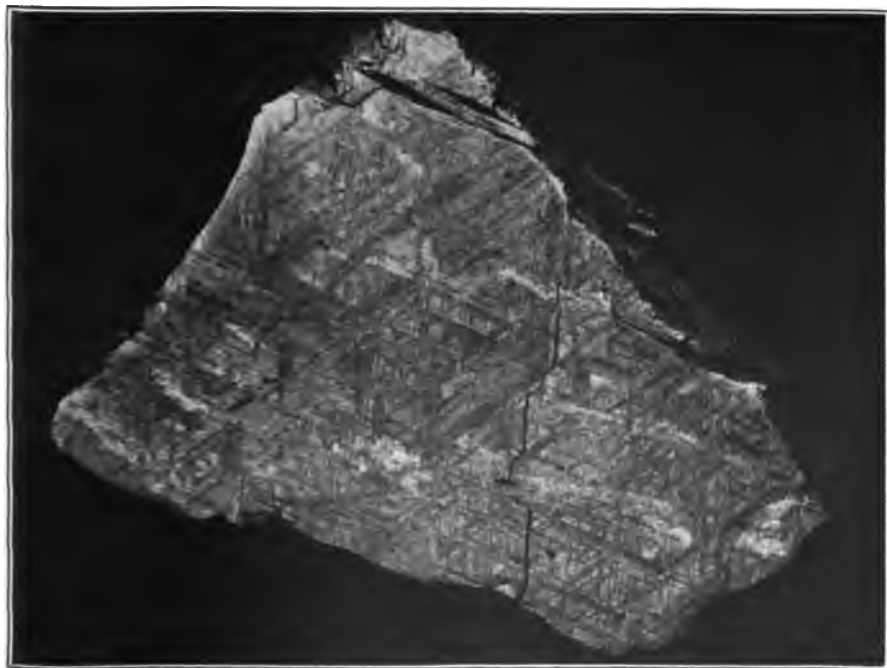
QUENGGOUK, BASSEIN DISTRICT, PEGU, BRITISH BURMA. No. 452.

Stone, Cc. Fragments, weighing 17 grams, from one of three fragments which fell December 27, 1857. This fall is of interest in that the stone broke so low in the atmosphere that the fractured surfaces were not all re-fused, and the three pieces could be fitted together, proving their common origin.

*Reference.*—M. W. Haidinger, *Das Meteor von Quenggouk, etc.*, *Sitz. Akad. Wiss. Wien*, vol. 44, 1861, p. 637.



1



2

POLISHED SURFACE OF (1) PERSIMMON CREEK AND (2) OF PUTNAM COUNTY IRONS.

FOR DESCRIPTIONS SEE PAGES 127 AND 130.





TWO VIEWS OF THE RICH MOUNTAIN STONE.

FOR DESCRIPTION SEE PAGE 132.





**RAFRUTI IN THE EMMENTHAL, CANTON BERN, SWITZERLAND. No. 261.**

Iron, Dn. Weight, 23 grams. Thin slice, 3 cm. by 3 cm., etched. Fell in 1856, according to researches of Dr. E. von Fellenberg. Weight of original mass, 18.2 kilograms.

*Reference*.—E. v. Fellenberg, Centr. Min. Geol. Pal., No. 5, 1900, pp. 152–158.

**RANCHITO, NEAR SAOUBIRITO, SINALOA, MEXICO. Nos. 162, 202.**

Iron, Off. Two rough pieces with polished surfaces; weight, 177 and 619 grams; fragment with original and etched surfaces, weighing 14 grams. Date of fall unknown; found in 1871. Weight of the original mass not accurately known. It was stated by Barcena<sup>1</sup> to be not less than 12 feet in length. Castillo, as quoted by Fletcher,<sup>2</sup> gives its dimensions as 3.65 by 2.0 by 1.5 meters, which would indicate that it would weigh not far from 50,000 kilograms. Ward gives the extreme dimensions as 13 feet 1 inch by 6 feet 2 inches by 5 feet 4 inches, and estimates its weight as 50 tons (!). (See cast No. 435.) Analyses by Cohen and Hildebrand yielded:

	Per cent.
Iron (Fe)-----	89.54
Nickel (Ni)-----	9.40
Cobalt (Co)-----	.98
Copper (Cu)-----	.02
Chromium (Cr)-----	.02
Phosphorus (P)-----	.12
Sulphur (S)-----	.02
Carbon (C)-----	.01
Chlorine (Cl)-----	.02
	100.13

The mass still lies where it fell in western Mexico, but has been protected from vandalism by the building over it of a stone house with doors of iron grating, through which the occasional visitor may view the monster.

*References*.—H. A. Ward, Proc. Rochester Acad. Sci., vol. 4, 1902, p. 67. E. Cohen, Mitt. nat. Ver. Neu-Vorpommern u. Rügen, vol. 35, 1903.

**RASGATA (TOCAVITA), PROVINCE OF BOYACA, COLOMBIA, SOUTH AMERICA. No. 437.**

Iron, Ds. Irregular slice some 155 by 80 by 8 mm., with elongated cone of troilite. Weight, 645 grams. From a mass obtained by H. A. Ward from Museum at Bogota, Colombia, in 1906.

<sup>1</sup> Proc. Acad. Nat. Sci. Phila., 1876, p. 122.

<sup>2</sup> Min. Mag., vol. 9, 1900, p. 151.

## REED CITY, OSCEOLA COUNTY, MICHIGAN. No. 316.

Iron, Om. Triangular piece, some 18 by 18 cm., weighing 263 grams. From a mass weighing 19.8 kilograms, or 43 pounds 11 ounces, found in 1895. A chemical analysis by J. E. Whitfield yielded: Iron, 89.386; nickel, 8.180.

*Reference.*—H. L. Preston, Proc. Rochester Acad. Sci., vol. 4, 1903, p. 89.

## RHINE VILLA (RHINE VALLEY?), SOUTH AUSTRALIA. No. 372.

Iron, Om. Section weighing 118 grams, found in 1901.

## HIGH MOUNTAIN, JACKSON COUNTY, NORTH CAROLINA. No. 362.

Stone, Cia. Weight, 179 grams. End of mass, showing one surface smooth sawn, one fractured surface with thin crust, and old surface with thicker crust (pl. 32). Weight of entire mass, so far as found, 668 grams. This, however, was plainly a fragment from a larger stone. Supposed to have been a portion of a fall which took place about June 20, 1903. Mineral composition, olivine, monoclinic and orthorhombic pyroxenes, and maskelynite, with the usual metallic and sulphide grains. Composition, as determined by W. Tassin, is as follows:

	Per cent.
Iron .....	7.070
Nickel .....	.730
Cobalt .....	.031
Troilite .....	3.890
Schreibersite .....	.200
Olivine .....	46.900
Insoluble silicates .....	40.670
Magnetite .....	.150
Graphite .....	.015
	<hr/>
	99.746

*Reference.*—G. P. Merrill, Proc. U. S. Nat. Mus., vol. 32, 1907, p. 241.

## ROCHESTER, FULTON COUNTY, INDIANA. No. 44.

Stone, Cc. Weight, 2 grams. Fragment with crust. Fell a little before 9 p. m. December 21, 1876, passing eastward over the states of Kansas, Missouri, Illinois, Indiana, and Ohio, the length of its observed track being from 1,000 to 1,100 miles. In various parts of its track it threw off fragments accompanied with the usual rumbling noise and commotion in the atmosphere common to the flight of these bodies. When crossing Indiana the main body was followed by a train of smaller bodies, many of them of the apparent size of Venus or Jupiter. Its velocity in reference to the earth's surface appeared to be from 8 to 12 miles a second. The pyrotechnic display is said

to have been transcendently beautiful, hardly equaled or surpassed by any previous occurrence of the kind. But one fragment fell to the ground, so far as known. This did not weigh over 400 grams. Analyses by J. Lawrence Smith yielded:

Constituents.	Soluble in HCl.	Insoluble in HCl.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica ( $\text{SiO}_2$ ).....	34.56	57.81
Iron protoxide ( $\text{FeO}$ ).....	27.75	11.04
Alumina ( $\text{Al}_2\text{O}_3$ ).....	Trace.	.23
Lime ( $\text{CaO}$ ).....	Trace.	5.31
Magnesia ( $\text{MgO}$ ).....	36.38	24.97
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....		.10
Soda ( $\text{Na}_2\text{O}$ ).....	.46	.84
	99.14	100.30

The metallic portion yielded:

	<i>Per cent.</i>
Iron (Fe).....	94.49
Nickel (Ni).....	4.12
Cobalt (Co).....	.51
	99.12

From the results were calculated the mineral proportions as follows:

	<i>Per cent.</i>
Bronzite and pyroxenic minerals.....	46.00
Olivine.....	41.00
Nickel-iron.....	10.00
Troilite.....	3.00
Chromite.....	.15
	100.15

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 14, 1877, p. 219.

**RODEO, DURANGO, MEXICO. No. 357.**

Iron, Om. Etched slab about 20 by 17 cm., weighing 1,782 grams. From a mass weighing 44.1 kilograms. Found about 1852 and now in the Field Museum, Chicago. Analysis by H. W. Nichols yielded:

	<i>Per cent.</i>
Iron (Fe).....	89.84
Nickel (Ni).....	8.79
Cobalt (Co).....	.28
Copper (Cu).....	.07
Phosphorus (P).....	.80
Sulphur (S).....	.02
Carbon (C).....	.09
	99.89

*Reference.*—O. C. Farrington, Field Col. Mus. Publ. 101, Geol. Ser., vol. 3, No. 1, 1905.

ROXBOROUGH (about 200 miles southeast of), NORTHWEST AUSTRALIA. Nos. 453, 490.

Iron, Om. Slice 50 by 50 mm., weighing 237 grams, and slice 60 by 80 mm., weighing 145 grams, gift of F. Hess. From a mass weighing 191.5 pounds, or 86.8 kilograms, found in 1894. The chemical composition as determined by Mariner and Haskins is:

	Per cent.
Iron (Fe)-----	90.914
Nickel (Ni)-----	8.330
Cobalt (Co)-----	.590
Phosphorus (P)-----	.156
Sulphur (S)-----	Trace.
Manganese (Mn)-----	?Trace.
Silicon (Si)-----	.01
Carbon (C)-----	Trace.
	<hr/> 100.00

Specific gravity, 7.78.

*Reference.*—H. A. Ward, Amer. Journ. Sci., vol. 5, 1898, p. 135.

BOWTON, WELLINGTON, ENGLAND. No. 86.

Iron, Om. Slice 4.2 by 1.2 cm. weighing 19.5 grams, from a mass weighing 3.5 kilograms or 7½ pounds, which fell on April 20, 1876. Composition as shown by analysis:

	Per cent.
Iron (Fe)-----	91.250
Nickel (Ni)-----	8.582
Cobalt (Co)-----	.871
Copper (Cu)-----	Trace.
	<hr/> 100.203

The iron sulphide was also analyzed and found to be troilite. Gas was determined to the amount of 6.38 times the bulk of the iron, having the following composition:

	Per cent.
Carbonic acid (CO <sub>2</sub> )-----	5.155
Hydrogen (H)-----	77.778
Carbon monoxide (CO)-----	7.845
Nitrogen (N)-----	9.722
	<hr/> 100.000

The great interest in this iron lies in the fact that it is one of the nine irons which have been seen to fall.

*Reference.*—W. Flight, History of Meteorites, 1887, p. 194.

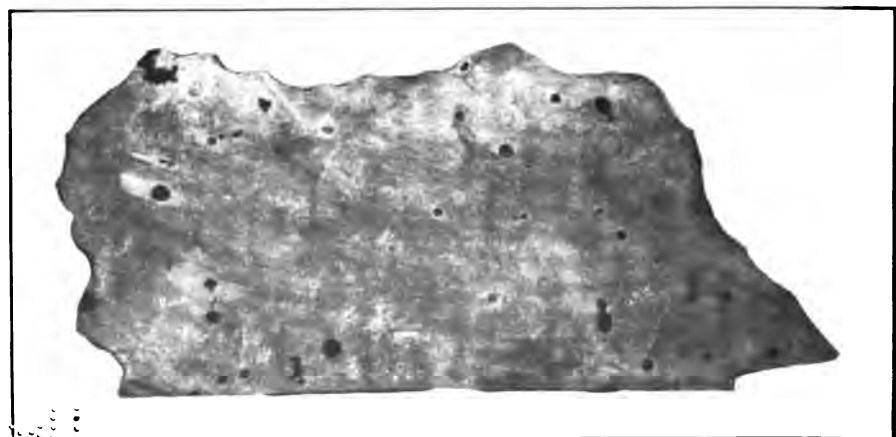




1



2



3

(1) ETCHED SLICE OF SACRAMENTO IRON; (2) DENDRITIC SCHREIBERSITE IN ARISPE IRON;  
(3) ETCHED SLICE OF SANTA ROSA IRON.

FOR DESCRIPTIONS SEE PAGES 12, 135, AND 143.

**RUFF'S MOUNTAIN, LEXINGTON COUNTY, SOUTH CAROLINA. No. 24.**

Iron, Om. Weight, 7 grams. Small slice with Widmanstätten figures. Weight of original mass, 53 kilograms (117 pounds). Date of fall unknown; found in 1844. Analysis by Shepard yielded:

	Per cent.
Iron (Fe)-----	96.00
Nickel (Ni)-----	3.121
Chromium (Cr)-----	Trace.
Sulphur (S)-----	Trace.
Cobalt (Co)-----	Trace.
Magnesium (Mg)-----	Trace.
	<hr/>
	99.121

*References.*—C. U. Shepard, Amer. Journ. Sci., vol. 10, 1850, p. 128; Proc. Amer. Assoc. Adv. Sci., vol. 3, 1850, p. 152.

**RUSSELL GULCH, GILPIN COUNTY, COLORADO. No. 186.**

Iron, Of. Rectangular section, 4.5 by 1.7 by 1.2 cm., weighing 76 grams. One original surface. From a mass weighing 13 kilograms (29 pounds), found in 1863. Analysis by J. Lawrence Smith yielded:

	Per cent.
Iron (Fe)-----	90.61
Nickel (Ni)-----	7.84
Cobalt (Co)-----	.78
Phosphorus (P)-----	.02
Copper (Cu)-----	Minute trace
	<hr/>
	99.25

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 43, 1867, p. 66.

**SACRAMENTO MOUNTAINS, EDDY COUNTY, NEW MEXICO. No. 230.**

Iron, Om. Weight, 4,420 grams. Slab 60 by 16 cm., with etched surface showing Widmanstätten figures (pl 33). Weight of original mass, 237 kilograms. Date of fall uncertain—perhaps 1876. Analysis by J. E. Whitfield yielded:

	Per cent.
Iron (Fe)-----	91.39
Nickel (Ni)-----	7.86
Cobalt (Co)-----	.52
	<hr/>
	99.77

*Reference.*—W. M. Foote, Amer. Journ. Sci., vol. 3, 1897, p. 65.

**SAINT FRANCOIS COUNTY, MISSOURI. Nos. 120, 427.**

Iron, Og. Weight, 276 grams; in two pieces—one a slice etched weighing 245 grams, one a fragment weighing 31 grams. In 1863 Shumard found a meteoric iron weighing 340 grams in the collections of the St. Louis Academy of Sciences and labeled as from southeast

Missouri. This was described by Shepard as an octahedral iron rich in schreibersite. Specific gravity, 7.015 to 7.112. The analysis yielded:

	Per cent.
Iron (Fe)-----	92.10
Nickel (Ni)-----	2.60
Schreibersite-----	5.00
	<hr/>
	99.70

Later a larger mass (weight not given) was found in St. Francois County, which is regarded as identical with that described above. This, according to Dr. J. Fahrenhorst's analyses, consists of:

	Per cent.
Iron (Fe)-----	92.68
Nickel (Ni)-----	6.97
Cobalt (Co)-----	.52
Copper (Cu)-----	.02
Chromium (Cr)-----	.00
Chlorine (Cl)-----	.03
Sulphur (S)-----	.01
Phosphorus (P)-----	.34
Silicate granules-----	.01
	<hr/>
	100.58

From this he calculates the mineral composition as follows:

	Per cent.
Nickel-iron-----	97.71
Schreibersite-----	2.20
Troilite-----	.03
Lawrencite-----	.05
Silicates-----	.01
	<hr/>
	100.00

Specific gravity of mass, 7.746 at 16° C.; specific gravity of nickel-iron, 7.7728.

*References.*—C. U. Shepard, Amer. Journ. Sci., vol. 47, 1869, p. 230. E. Cohen, Ann. k. k. Naturhist. Hofmus., vol 15, 1900, p 369.

SAINTE GENEVIEVE COUNTY, MISSOURI. No. 444.

Iron, Of. Triangular slice 55 by 35 by 15 mm., weighing 129 grams, from a mass weighing 539 pounds (244 kilograms), found in 1888. Chemical analysis by J. E. Whitfield yielded:

	Per cent.
Iron (Fe)-----	91.58
Nickel (Ni)-----	7.98
Cobalt (Co)-----	.29
Silicon (Si)-----	.023
Phosphorus (P)-----	.200
Sulphur (S)-----	Trace.
Carbon (C)-----	Nona.
	<hr/>
	100.073

*Reference.*—Henry A. Ward, Proc. Rochester Acad. Sci., vol. 4, 1901, p. 65.

**SAINT MARK'S MISSION STATION, CAPE COLONY, SOUTH AFRICA. No. 496.**

Stone, Cc. A 250-gram fragment from a stone weighing 13.783 kilograms, which fell on January 3, 1903, burying itself to a depth of 2 feet in cultivated land. An unusually firm and hard, dark gray chondritic stone, consisting mainly of olivine, enstatite, nickel-iron, and troilite. An analysis yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	38.29
Alumina ( $\text{Al}_2\text{O}_3$ )	.64
Ferrous oxide ( $\text{FeO}$ )	6.50
Manganous oxide ( $\text{MnO}$ )	.33
Magnesia ( $\text{MgO}$ )	18.23
Lime ( $\text{CaO}$ )	1.08
Iron ( $\text{Fe}$ )	26.44
Nickel ( $\text{Ni}$ )	1.84
Cobalt ( $\text{Co}$ )	.21
Manganese ( $\text{Mn}$ )	.29
Calcium ( $\text{Ca}$ )	.28
Sulphur ( $\text{S}$ )	5.26
Phosphorus ( $\text{P}$ )	.05
Chlorine ( $\text{Cl}$ )	.27
Carbon ( $\text{C}$ )	.36
Potash ( $\text{K}_2\text{O}$ )	.23
Soda ( $\text{Na}_2\text{O}$ )	.85
	101.15

The percentage mineral composition as calculated from this analysis is: Enstatite, 45.96; other silicates (mainly olivine), 19.45; nickel-iron, 19.27; troilite, 14.05; schreibersite, 0.32; oldhamite, 0.18; calcium chloride, 0.41; carbonaceous matter, 0.36.

*References.*—E. Cohen, Ann. S. African Mus., vol. 5, 1906, pp. 1–16. Also Neues Jahrb. Min. Geol. Pal., vol. 1, 1907, p. 370.

**SAINT MESMIN, NEAR TROYES, DEPARTMENT OF AUBE, FRANCE. No. 262.**

Stone, Cib or Cgb. Weight, 69 grams; fragment with crust. Dark gray with light areas; chondritic. Fell May 30, 1866, at about 3.45 a. m. Original weight, 8.27 kilograms (according to Daubree, three stones weighing, respectively, 4.2, 2.21, and 1.86 kilograms). Analyses by M. Pisani, as follows:

Constituents.	Bulk.	Soluble in HCl, 50.4 per cent.	Insoluble in 40.6 per cent.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Silica (SiO <sub>2</sub> ).....	38.10	17.00	21.10
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	3.00	.....	3.00
Magnesia (MgO).....	25.64	19.54	6.10
Ferrous oxide (FeO).....	17.21	11.84	5.37
Manganous oxide (MnO).....	Traces.	.....	.....
Alkalies.....	3.13	1.92	1.21
Lime (CaO).....	1.09	.....	1.09
Iron (Fe).....	4.94	4.94	.....
Nickel (Ni).....	.73	.73	.....
Troilite.....	2.99	2.99	.....
Chromite.....	2.18	.....	2.18
	99.00	58.96	40.06

*References.*—Daubree, *Compt. Rend.*, vol. 62, 1866, pp. 1305–1310.  
M. Pisani, *Compt. Rend.*, vol. 62, 1866, p. 1326.

SAINT MICHEL, FINLAND. No. 448.

Stone, Ro(?). Irregular fragment, with no crust, approximately 85 by 60 by 20 mm. and weighing 625 grams, from a mass weighing some 7 kilograms which fell July 12, 1910, at 7.25 p. m. An analysis by L. H. Borgström showed:

	Per cent.
Iron (Fe).....	11.71
Nickel (Ni).....	1.16
Cobalt (Co).....	.13
Copper (Cu).....	.01
Silica (SiO <sub>2</sub> ).....	39.52
Titanic oxide (TiO <sub>2</sub> ).....	.02
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	3.31
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ).....	.56
Ferrous oxide (FeO).....	13.44
Manganous oxide (MnO).....	.41
Lime (CaO).....	1.64
Magnesia (MgO).....	24.60
Potash (K <sub>2</sub> O).....	.13
Soda (Na <sub>2</sub> O).....	1.32
Phosphorus (P).....	.08
Sulphur (S).....	2.22
	100.26

The component minerals were also analyzed and the mineral composition calculated as:

	Per cent.
Nickel-Iron.....	8.71
Schreibersite.....	.51
Troilite.....	6.11
Chromite.....	.82
Olivine.....	43.22
Bronzite.....	26.25
Plagioclase.....	14.25
	<hr/> 100.25

*Reference.*—L. H. Borgström, Bull. Comm. geol. Finlande, No. 34, 1912.

**SALINE TOWNSHIP, KANSAS. No. 301.**

Stone, Cck. Irregular mass, with crust on one side, weighing 589 grams. From a stone weighing upward of 20 kilograms found in 1898. Nothing known of fall. Analysis by H. W. Nichols yielded:

	Per cent.
Silica ( $\text{SiO}_2$ ).....	37.08
Alumina ( $\text{Al}_2\text{O}_3$ ).....	1.83
Ferrous oxide ( $\text{FeO}$ ).....	18.04
Magnesia ( $\text{MgO}$ ).....	23.34
Lime ( $\text{CaO}$ ).....	2.03
Soda ( $\text{Na}_2\text{O}$ ).....	.26
Potash ( $\text{K}_2\text{O}$ ).....	.08
Iron ( $\text{Fe}$ ).....	7.89
Nickel ( $\text{Ni}$ ).....	.95
Cobalt ( $\text{Co}$ ).....	.04
Sulphur ( $\text{S}$ ).....	1.65
Phosphorus ( $\text{P}$ ).....	.05
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ).....	4.45
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....	1.25
Nickel oxide ( $\text{NiO}$ ).....	.74
Cobalt oxide ( $\text{CoO}$ ).....	.07
Water ( $\text{H}_2\text{O}$ ).....	1.23
	<hr/> 100.98

*References.*—O. C. Farrington, Science, vol. 16, 1902, p. 67; Field Columbian Mus. Publ. 122, Geol. Ser., vol. 3, No. 6, 1907; Publ. 151, vol. 3, No. 9, 1911.

**SALLES, NEAR VILLEFRANCHE, RHONE, FRANCE. No. 303.**

Stone, Cia. Weight, 41 grams; fragment, with crust. Shows well the pseudofragmental structure. Fell about 6 p. m. on the afternoon of March 12 (according to some authorities, the 8th), 1798, the flight being from the east toward the west. In falling buried itself for some 18 inches in the soft soil. Original weight, 10 kilograms.

Vauquelin's analysis, the only thus far made, is of historical interest only. It is as follows:

	Per cent.
Silica ( $\text{SiO}_2$ )	46
Iron oxide ( $\text{Fe}_2\text{O}_3$ )	38
Magnesia ( $\text{MgO}$ )	15
Nickel ( $\text{Ni}$ )	2
Lime ( $\text{CaO}$ )	2
	<hr/> 103

The presence of sulphur was also recognized.

*Reference.*—M. De Dree, *Tilloch's Philosophical Magazine*, London, vol. 16, 1803, p. 217.

SALT LAKE CITY, UTAH. No. 107.

Stone, Cgb. Three grams from a stone weighing 175 grams which was found in 1869.

SAMS VALLEY, JACKSON COUNTY, OREGON. No. 510.

Iron, Om. Rhomboidal fragment weighing 22 grams. Two faces at angles of  $45^\circ$  to one another, etched. This is the fragment shown in figure 3 of Foote's paper cited below. From a mass weighing 6,900 grams ( $15\frac{1}{4}$  pounds), found in 1894. Analysis by J. E. Whitfield yielded:

	Per cent.
Silicon (Si)	0.009
Sulphur (S)	.056
Nickel (Ni)	9.160
Cobalt (Co)	.640
Copper (Cu)	.016
Carbon (C)	.100
Iron (Fe)	83.800
	<hr/> 93.781
Schreibersite	6.194
	<hr/> 99.975

Analysis of the schreibersite yielded: Iron, 65.13; nickel, 20.93; phosphorus, 13.94.

*Reference.*—W. M. Foote, *Amer. Journ. Sci.*, vol. 39, 1915, p. 81.

SAN ANGELO, TOM GREEN COUNTY, TEXAS. NO. 256.

Iron, Om. Weight, 607 grams. Slab 7 by 25 cm., etched to show structure. Date of fall unknown; found July, 1897. Weight of original mass, 88 kilograms (194 pounds). Composition:

	Per cent.
Iron (Fe)-----	91.958
Nickel (Ni)-----	7.860
Cobalt (Co)-----	Trace.
Copper (Cu)-----	.040
Phosphorus (P)-----	.099
Sulphur (S)-----	.032
Manganese (Mn)-----	Trace.
Silicon (Si)-----	0.011
Carbon (C)-----	Trace.
	<hr/> 100.00

Specific gravity, 7.7.

Reference.—H. L. Preston, *Amer. Journ. Sci.*, vol. 5, 1898, p. 269.

**SANCHEZ ESTATE, COAHUILA, MEXICO. No. 389.**

Iron, H. Original weight, 114,300 grams. Weight of main mass now in Museum, 104,773 grams (see pl. 17, fig. 2). This is one of several masses of meteoric iron found in Coahuila, Mexico, and which are commonly regarded as belonging to one and the same fall. These irons are known as the Bonanza masses (14), the Butcher masses (8), the Santa Rosa mass (1), and the Sanchez, Couch, or Smithsonian mass (1). Concerning the date of fall, it can only be said that in the autumn of 1835 a brilliant meteorite was seen to pass over the town of Santa Rosa, in the State of Coahuila, passing in a north-westerly direction and disappearing in the mountains. Immediately after its disappearance a series of explosions were heard, and shortly after a 12-pound piece of iron was brought into Santa Rosa, which was a fragment of one of the eight masses noted above. These were subsequently brought into the United States from the region some 90 miles northwest of the town by Dr. H. B. Butcher. This particular mass (the Sanchez Estate) was secured in 1854 by Lieut. D. N. Couch<sup>1</sup> and presented to the Smithsonian Institution. While its composition and structure, as well as its source, are indicative of its being a part of the fall noted above, there is no absolute proof of the same. The composition of the iron, as given by J. Lawrence Smith, is as below:

	Per cent.
Iron (Fe)-----	95.82
Cobalt (Co)-----	.35
Nickel (Ni)-----	3.18
Phosphorus (P)-----	.24
Copper (Cu)-----	Trace
	<hr/> 99.59

<sup>1</sup> Erroneously spelled *Couch* and *Gouch* by various writers.

This would correspond to:

	Per cent.
Nickelliferous iron.....	98.45
Schreibersite .....	1.55
	<hr/> 100.00

According to Brezina, the iron belongs to the group of Hexahedrites, showing on etched surface a hexahedral structure and cleavage.

*References.*—L. Fletcher, On the Mexican meteorites. *Min. Mag. and Journ.*, vol. 9, 1890, pp. 91-175; also bibliography given by Wülfing.

**SAN EMIGDIO, SAN BERNARDINO COUNTY, CALIFORNIA. Nos. 123, 237.**

Stone, Cc. Weight, 527 grams, in small fragments, the material having been put through an ore crusher for assaying before its true nature was known. Original mass said to have weighed 80 pounds (36,280 grams). Found by a prospector in the San Emigdio Mountains and nothing known regarding its fall and the main mass now lost. All fragments badly oxidized. Chemical composition:

	Per cent.
Metallic portion.....	6.21
Soluble in HCl.....	52.19
Insoluble in HCl.....	41.60
	<hr/> 100.00

Specific gravity, 3.57.

The metallic portion yielded 88.25 iron, 11.27 nickel, 0.48 cobalt.

Mineral composition: Olivine, enstatite, pyrrhotite, and iron.

Structure: Chondritic, tufaceous.

Gifts of Thomas Price and George P. Merrill.

*Reference.*—Geo. P. Merrill, On the San Emigdio meteorite. *Proc. U. S. Nat. Mus.*, vol. 11, 1888, pp. 161-167.

**SAN LUIS POTOSI, MEXICO. No. 73.**

Iron. (See Descubridora.)

**SANTA CATHARINA, RIO SAN FRANCISCO DO SUL, BRAZIL. No. 104.**

Iron, Dn (or Df). Weight, 82.4 grams. Mass but slightly altered, polished surface having a good metallic luster.

Large masses of this iron, of which some 137,453 grams are accounted for by Wülfing, were found in 1873 scattered over a triangular area of about 10,200 square meters. There is no positive evidence for or against its meteoric nature. The probabilities, however, seem to favor a meteoric origin, though anomalous from its high content in nickel.

The composition of the iron as given by E. Guignet and G. Ozorio de Almeida is: Iron, 64; nickel, 36. Damour gave the following results: Iron, 63.90; nickel, 33.97; cobalt, 1.48; sulphur, 0.16; phosphorus, 0.05; carbon, 0.20; silicon, 0.01. Specific gravity, 7.75. The

iron is of more than ordinary hardness. Some 25,000 kilograms were sent to England to be smelted for nickel.

*References.*—E. Guignet and G. Ozorio de Almeida, *Compt. Rend.*, vol. 83, 1876, pp. 917–919. A. Damour, *Compt. Rend.*, vol. 84, 1877, p. 478. *Amer. Journ. Sci.*, vol. 36, 1888, p. 157 (abstract as to occurrence).

**SANTA ROSA, COAHUILA, MEXICO. No. 29.**

Iron, H. Fragment, weighing 19.3 grams, from a mass brought by N. T. Lupton from near Santa Rosa, State of Coahuila, Mexico. It was stated to have been found in 1837, in the desert between Santa Rosa and the city of Chihuahua, and to have been brought into Santa Rosa by a Mexican named Juan Garca. The original mass was irregular in outline, the dimensions being about 33 by 28 by 21 cm., and the estimated weight 8.73 kilograms. An analysis by Lupton yielded:

	Per cent.
Iron (Fe).....	91.86
Nickel (Ni).....	7.42
Cobalt (Co).....	.50
Phosphorus (P).....	.27
	<hr/> 100.05

*Reference.*—N. T. Lupton, *Amer. Journ. Sci.*, vol. 29, 1885, p. 232.

**SANTA ROSA, PROVINCE OF BOYACA, COLOMBIA, SOUTH AMERICA. Nos. 361, 460.**

Iron, Obz. Two slices—one weighing 442 grams and one, 400 by 180 by 10 mm., weighing 3,837 grams (pl. 33). The last named from a mass secured by H. A. Ward in 1906. Etched, showing brecciated structure and numerous troilite nodules. An analysis by O. Sjöström yielded:

	Per cent.
Iron (Fe).....	92.30
Nickel (Ni).....	6.52
Cobalt (Co).....	.78
Copper (Cu).....	.02
Chromium (Cr).....	trace
Carbon (C).....	.18
Phosphorus (P).....	.36
Sulphur (S).....	.04
	<hr/> 100.20

*Reference.*—E. Cohen, *Meteoreisen Studien* 8, *Ann. k. k. Naturhist. Hofmus.*, vol. 13, 1899.

**SÃO JULIAO DE MOREIRA, NEAR PONTE DE LIMA, MINHO, PORTUGAL. Nos. 287, 314.**

Iron, Ogg. Two slices, one irregularly 60 by 60 by 5 mm., weighing 164 grams, and one 14 by 7.5 cm. by 8 mm., weighing 671 grams.

Etched and showing peculiar schreibersite markings. Date of fall unknown. First came to notice in 1883, and described in 1888. Weight of original mass some 162 kilograms. Composition according to analyses by C. von Bonhorst: Iron, 89.39; nickel and cobalt, 8.27; phosphorus, 0.26, with a trace of copper.

*Reference.*—See Wülfing, p. 308.

SAREPTA, SARATOV, RUSSIA. No. 455.

Iron, Og. Slice about 35 by 40 mm., weighing 124 grams, from a mass weighing 14,325 grams, found in 1854. Auerbach's analysis yielded:

	Per cent.
Iron (Fe).....	95.927
Nickel (Ni).....	2.657
Silicon (Si).....	.020
Tin (Sn).....	.017
Schreibersite.....	1.315
	<hr/> 99.936

*Reference.*—W. Haidinger, Sitz. Akad. Wiss. Wien, vol. 46, 1862, p. 286; 49, 1864, p. 497.

SCHÖNENBERG, PFAFFENHAUSEN, SCHWABEN, BAVARIA. No. 220.

Stone, Cwa. Weight, 8 grams. Fragment with small area of crust. Mass dark gray with light and dark chondrules and metallic grains, traversed by dark veins. Fell December 25, 1846, at 2 p. m. Was traveling in, at first, a northeast and finally southeast direction. The fall was accompanied by the usual cannon-like report, and the stone, weighing 8 kilograms, 15 grams, buried itself in the soil to a depth of 2 feet. Analyses by Gümbel yielded:

Constituents.	Bulk analysis.	55.18 per cent soluble in HCl.	44.82 per cent insoluble in HCl.
Silica (SiO <sub>2</sub> ).....	40.13	24.47	57.85
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	5.57	9.45	6.75
Iron (Fe).....	13.77	30.56	.....
Nickel (Ni).....	1.47	1.48	1.44
Sulphur (S).....	1.93	3.52	.....
Phosphorus (P).....	0.36	.33	.27
Chromite.....	.60	.....	1.25
Iron protoxide (FeO).....	17.12	10.41	15.37
Lime (CaO).....	2.31	3.72	.56
Magnesia (MgO).....	13.81	11.55	16.63
Potash (K <sub>2</sub> O).....	.73	1.33	Trace.
Soda (Na <sub>2</sub> O).....	2.20	3.18	1.02
	100.00	100.00	101.24

From these results Gumbel calculated the mineral composition to be:

	Per cent.
Olivine.....	10.00
Feldspathic and scapolite-like mineral.....	18.50
Augitic mineral.....	40.00
Nickel-iron.....	14.50
Pyrrhotite.....	5.00
Schreibersite.....	2.00
Chromite.....	1.00
	<hr/> 100.00

The stone is described as chondritic, finely granular, and so friable as to be readily crushed between the thumb and fingers.

*Reference.*—Gumbel, Sitz. k. bayr. Akad. Munchen, vol. 1, 1878, p. 40.

**SCOTT CITY, KANSAS. No. 489.**

Stone, Cc. Weight, 175 grams. Weight of main mass, 1,900 grams. Found in November, 1911. A very dense chondritic stone consisting of the usual olivine and pyroxenes, and of which no analysis has been made.

*Reference.*—G. P. Merrill, Proc. U. S. Nat. Mus., vol. 42, 1912, pp. 295–296.

**SCOTTSVILLE, ALLEN COUNTY, KENTUCKY. No. 77.**

Iron, H. Weight, 99.8 grams. In two pieces; a section, weighing 66.5 grams, contains troilite nodules, and one, weighing 33.5 grams, etched, shows also troilite nodules and presents a granular or stippled surface overlaid with a network of fine lines. Date of fall unknown; found in June, 1867. Original weight about 10 kilograms; dimensions, 14 by 18 by 16 cm.

The markings on an etched surface are exceedingly fine and require the aid of a lens to distinguish them. There appear to be two sets of figures—one of long, very fine lines, representing octahedral cleavage, and the other series being smaller, more crowded, and barely perceptible. (Whitfield).

Analysis by Whitfield yielded:

	Per cent.
Iron (Fe).....	94.32
Nickel (Ni).....	5.01
Cobalt (Co).....	Trace
Sulphur (S).....	0.34
Phosphorus (P).....	.16
Carbon (C).....	.12
	<hr/> 99.95

Specific gravity, 7.848.

*Reference.*—J. E. Whitfield, *Amer. Journ. Sci.*, vol. 33, 1887, p. 500.

SCRIBA, OSWEGO COUNTY, NEW YORK No. 48

Iron, Dn (or Df). Weight, 9.15 grams. A fragment with etched surface but having a granular or stippled appearance and no Widmanstätten figures. Date of fall unknown; found in 1835. Original weight, 3.6 kilograms (8 pounds). Analysis by Shepard yielded:

	Per cent.
Iron (Fe).....	99.66
Silicon (Si).....	.20
Calcium (Ca).....	.09
Aluminum (Al).....	Traces.
	<hr/> 99.95

The iron was found in a forest near charcoal pits. It gives no Widmanstätten figures on etched surfaces nor does it contain nickel or cobalt. Its meteoric nature is commonly considered as doubtful.

*References.*—C. U. Shepard, *Amer. Journ. Sci.*, vol. 40, 1841, p. 366; vol. 4, 1847, p. 75.

SEARSMONT, WALDO COUNTY, MAINE. Nos. 4, 190.

Stone, Cc. Two fragments from interior, weighing 12 and 20 grams. Fell at 8.15 a. m. on May 21, 1871. The fall was accompanied by the usual report and a hissing sound compared to the escape of steam from a boiler. The passage was from the north toward the south. On striking the ground, it buried itself to a depth of 2 feet and was broken into several pieces, the largest of which weighed 2 pounds. The structure is chondritic. Analyses by J. Lawrence Smith yielded:

	Per cent.
Nickeliferous iron.....	14.63
Pyrrhotite .....	3.06
Olivine .....	43.04
Bronzite, etc. (including chromite).....	39.27
	<hr/> 100.00

The metallic portion yielded:

Iron (Fe).....	90.02
Nickel (Ni) .....	9.05
Cobalt (Co) .....	.43
	<hr/> 99.50

The silicate portion yielded:

Constituents.	Soluble in HCl. 52.30.	Insoluble in HCl. 47.70.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica (SiO <sub>2</sub> ).....	40.61	56.25
Protoxide of iron (FeO).....	19.21	13.02
Magnesia (MgO).....	36.34	24.14
Sulphide of iron (FeS).....	3.06	.....
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	.....	2.01
Alkalies.....	.....	2.10
	99.22	97.52

Gifts of A. C. Hamlin and L. T. Chamberlain.

*References.*—C. U. Shepard, *Amer. Journ. Sci.*, vol. 2, 1871, p. 133.  
J. L. Smith, *Amer. Journ. Sci.*, vol. 2, 1871, p. 200.

**SEELÄNGEN, BRANDENBURG, PRUSSIA. No. 99.**

Iron, Ogg. Weight, 105 grams. Etched section showing irregular plates. Date of fall unknown. Found in 1847. Original weight, 102 kilograms. Composition as given by Duflos:

	<i>Per cent.</i>
Iron (Fe).....	90.000
Nickel (Ni).....	5.308
Cobalt (Co).....	.434
Manganese (Mn).....	.912
Copper (Cu).....	.104
Silica (SiO <sub>2</sub> ).....	1.157
Residue.....	.834
	98.749

As given by Rammelsberg:

	<i>Per cent.</i>
Iron (Fe).....	92.33
Nickel (Ni).....	6.23
Cobalt (Co).....	.67
Silicon (Si).....	.02
Carbon (C).....	.52
Residue.....	.18
	99.95

Specific gravity, 7.63–7.71.

*Reference.*—A. Duflos, *Pogg. Ann.*, ser. 3, vol. 74, 1848, p. 61.

**SELMA, DALLAS COUNTY, ALABAMA. No. 396.**

Stone, Cc. Weight, 120 grams. Irregular fragment, portion of a complete individual weighing some 140.6 kilograms (310 pounds); being therefore one of the largest of the stony meteorites. Found in 1907. Nothing definitely known regarding its fall. A dense, dark

gray stone, sufficiently compact to receive a polish. Chondrules abundant. Metallic portion inconspicuous to the unaided eye. Mineral composition: Olivine and orthorhombic and monoclinic pyroxenes, with some isotropic matter, metallic iron, and iron sulphide (pl. 34).

Chemical analysis by Whitfield yielded as follows:

	Per cent.
Silica ( $\text{SiO}_2$ )	31.06
Alumina ( $\text{Al}_2\text{O}_3$ )	4.30
Phosphoric acid ( $\text{P}_2\text{O}_5$ )	.25
Chromic oxide ( $\text{Cr}_2\text{O}_3$ )	.41
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	18.15
Ferrous oxide ( $\text{FeO}$ )	13.07
Manganous oxide ( $\text{MnO}$ )	.28
Nickel oxide ( $\text{NiO}$ )	1.45
Cobalt oxide ( $\text{CoO}$ )	.15
Lime ( $\text{CaO}$ )	2.13
Magnesia ( $\text{MgO}$ )	21.21
Soda ( $\text{Na}_2\text{O}$ )	3.96
Potash ( $\text{K}_2\text{O}$ )	.07
Vanadium oxide ( $\text{V}_2\text{O}_5$ )	Trace.
Water ( $\text{H}_2\text{O}$ )	8.07
Trollite { (S)	.19
(Fe)	.82
	100.05

Considering the metallic portion alone, the results were as follows, in totals:

	Per cent.
Iron	25.866
Chromium	.127
Nickel	1.470
Cobalt	.090
Manganese	.210
Vanadium	Trace.
	27.763

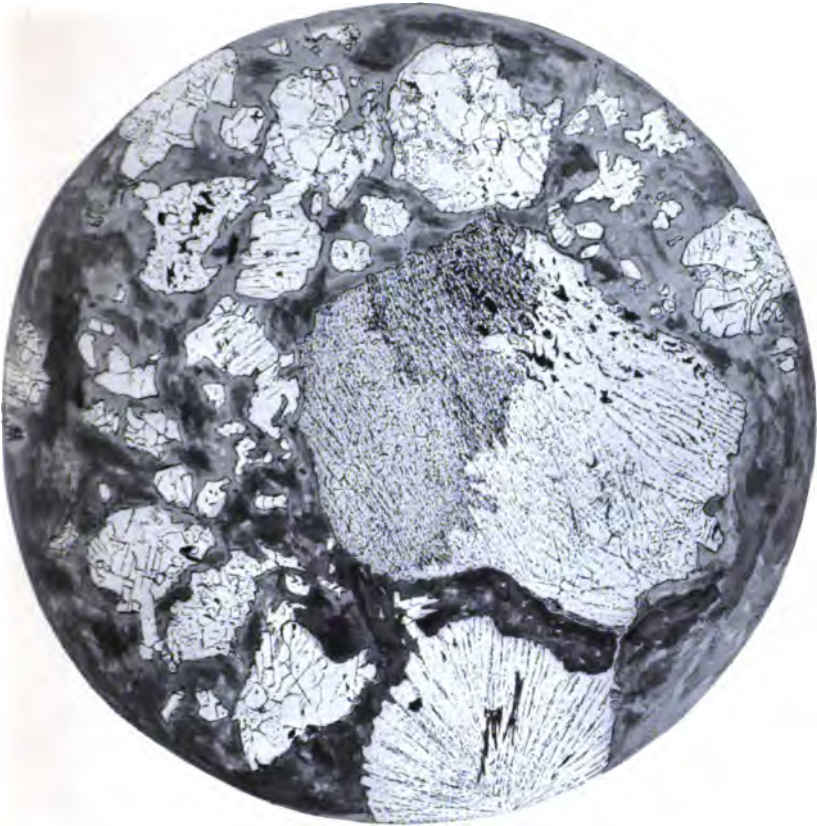
Gift of the American Museum of Natural History.

*References.*—Geo. P. Merrill, *Proc. U. S. Nat. Mus.*, vol. 32, 1907, pp. 59-61; *Mem. Nat. Acad. Sci.*, vol. 14, 1916, p. 16.

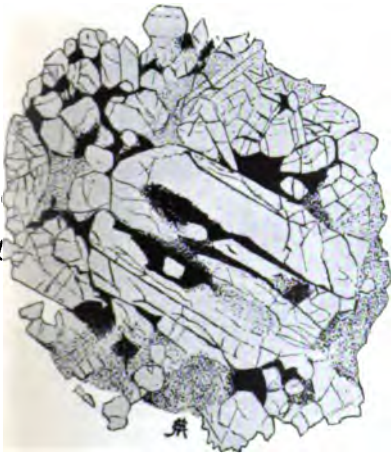
SENHADJA, AUMALE, CONSTANTINE, ALGERIA. No. 150.

Stone, Cwa. Weight, 18 grams. Fragment with light brown crust. Fell between 11 a. m. and 12 m. on August 25, 1865. Fall accompanied by usual report. Two stones fell at points some 4,800 meters apart. Original weight of both masses, 50 kilograms. Seems never to have been analyzed or subjected to microscopic examination; nickel, iron, pyrrhotite, chromite, in ash-gray silicate groundmass.

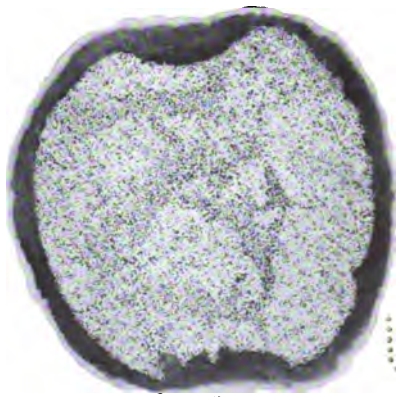
*Reference.*—Daubree, *Compt. Rend.*, vol. 62, 1866, p. 72.



1



2



3

**MICROSTRUCTURE OF THE SELMA STONE.**

FOR DESCRIPTION SEE PAGE 147.

24

**SHALKA, NEAR BISSAMPOR IN BANCOORAH, BENGAL, INDIA. No. 344.**

Stone, Chl. Weight, 53 grams. Fragment with crust. Fell three hours before sunrise on the morning of November 30, 1850. The weight of the original mass is not known, some 3,626 grams only being accounted for in Wülfing's catalogue.

Composition, according to H. B. von Foullon:  $\text{SiO}_2$ , 52.51;  $\text{Cr}_2\text{O}_3$ , 1.25;  $\text{FeO}$ , 16.81;  $\text{Al}_2\text{O}_3$ , 0.66;  $\text{CaO}$ , 0.89;  $\text{MgO}$ , 28.35;  $\text{NaO}$ , 0.22;  $\text{S}$ , 0.14;  $\text{Fe}$ , 0.25;  $\text{P}$ , trace. The mineral composition as given is bronzite, with inclosures of chromite, dark and light brown glass, picotite (?), and a little pyrrhotite. No native iron. The structure is remarkably coarsely granular; color light ash gray.

*Reference.*—H. B. von Foullon, Ann. k. k. Naturhist, Hofmus., vol. 3, 1885, p. 195. This gives a full review of all previous work.

**SHELSBURNE, GREY COUNTY, ONTARIO, CANADA. No. 364.**

Stone, Cga. Fragment weighing 578 grams from one of two stones which fell on the evening of August 13, 1904. The stones weighed, respectively, 12.6 kilograms and 6 kilograms, or together 40½ pounds. Though the stones fell with such force as to penetrate the ground to a depth of 2 feet, the heat was so slight that a green burdock leaf carried by it into the ground was still green and uncharred when disinterred. An analysis as given by L. H. Borgström yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	39.19
Iron (Fe)	10.70
Nickel (Ni)	.78
Cobalt (Co)	.04
Ferrous oxide ( $\text{FeO}$ )	15.16
Manganous oxide ( $\text{MnO}$ )	.12
Alumina ( $\text{Al}_2\text{O}_3$ )	2.15
Chromic oxide ( $\text{Cr}_2\text{O}_3$ )	.62
Lime ( $\text{CaO}$ )	1.75
Magnesia ( $\text{MgO}$ )	28.24
Potash ( $\text{K}_2\text{O}$ )	.22
Soda ( $\text{Na}_2\text{O}$ )	.73
Sulphur (S)	1.61
Phosphorus (P)	.06
	<hr/> 99.37

From the analysis and microscopic examination it was possible to calculate the mineral composition, as follows:

	Per cent.
Nickel-iron	8.50
Troilite	4.50
Chromite	.80
Schreibersite	.40
Olivine	45.00
Enstatite	27.80
Maskelynite (?)	13.00
	<hr/> 100.00

*Reference.*—L. H. Borgström, Trans. Roy. Astr. Soc. Canada, 1904, p. 69.

SHERGOTTY, BEHAR, BENGAL, INDIA. No. 321.

Stone, She. Fragment with crust, weighing 286 grams, from a mass weighing 4.5 kilograms, or 10 pounds 6 ounces, which fell on August 25, 1865. This stone belongs to a rare group, consisting essentially of pyroxene and maskelynite, with accessory magnetite. The chemical composition as given by Tschermak is as follows:

	Per cent.
Silica ( $\text{SiO}_2$ )	50.21
Alumina ( $\text{Al}_2\text{O}_3$ )	5.90
Ferrous oxide ( $\text{FeO}$ )	17.59
Magnesia ( $\text{MgO}$ )	10.00
Lime ( $\text{CaO}$ )	10.41
Soda ( $\text{Na}_2\text{O}$ )	1.28
Potash ( $\text{K}_2\text{O}$ )	.57
Magnetite ( $\text{FeO}$ , $\text{Fe}_3\text{O}_4$ )	4.57
	<hr/> 100.53

*Reference.*—G. Tschermak, Min. Mitth., vol. 2, 1872, p. 87.

SHINGLE SPRINGS, ELDORADO COUNTY, CALIFORNIA. No. 103.

Iron, Dsh. Weight, 32.4 grams. Date of fall unknown; found 1869–70. Original weight, 38.5 kilograms (85 pounds). This iron has been described and analyzed, with somewhat variable results, by C. U. Shepard, C. T. Jackson, and B. Silliman. Silliman's analysis follows:

	Per cent.
Iron (Fe)	81.48
Nickel (Ni)	17.173
Cobalt (Co)	.004
Aluminum (Al)	.088
Chromium (Cr)	.020
Magnesium (Mg)	.010
Calcium (Ca)	.163
Carbon (C)	.071
Silicon (Si)	.032
Phosphorus (P)	.308
Sulphur (S)	.012
Potassium (K)	.026
	<hr/> 99.987

Specific gravity, 7.875.

*References.*—C. U. Shepard, Amer. Journ. Sci., vol. 3, 1872, p. 438. C. T. Jackson, Amer. Journ. Sci., vol. 4, 1872, p. 495. B. Silliman, Amer. Journ. Sci., vol. 6, 1873, p. 18.

## SHREWSBURY, YORK COUNTY, PENNSYLVANIA. No. 422.

Iron, Om. Irregular slice some 12 by 7 cm., weighing 425 grams, from a mass weighing some 27 pounds (12.2 kilograms), found in 1909. An analysis by Dickman and Mackenzie, as given by Farrington, is as follows:

	Per cent.
Iron (Fe).....	90.84
Nickel (Ni).....	8.80
Cobalt (Co).....	Trace.
Sulphur (S).....	.01
Phosphorus (P).....	.29
	<hr/> 99.94

*Reference.*—O. C. Farrington, Amer. Journ. Sci., vol. 29, 1910. p. 350.

## SITATHALI, NEAR MURRAH, RAIPUR, RAJPUTANA, INDIA. No. 91.

Stone, Cho. Weight, 13.5 grams. Fragment with crust. Fell March 4, 1875. Two pieces found at distance of three-fourths mile from one another; total weight, 1,413 grams. The stone seems never to have been analyzed or otherwise described.

## SLOBODKA, JUCHNOW, SMOLENSK, RUSSIA. No. 171.

Stone, Cc. Three and one-half grams from a stone weighing 2.75 kilograms, which fell August 10, 1818.

Gift of R. de Kroustchoff.

## SMITH'S MOUNTAIN, ROCKINGHAM COUNTY, NORTH CAROLINA. No. 94.

Iron, Of. A slab weighing 58.8 grams from a mass weighing 5 kilograms, found about 1863.

## SMITHVILLE, DEKALB COUNTY, TENNESSEE. No. 202.

Iron, Og. Weight, 214 grams. Section with original and polished surface, showing large troilite nodule. Three of these irons were found, weighing, respectively, about 7, 15, and 65 pounds each. They were plowed up in a field in 1840 and date of fall is unknown. The largest mass, as described by Huntington, was remarkable for its silver-white color and in carrying a nodule of fine-grained, compact graphite, nearly 2 inches in diameter. In addition, the iron carries schreibersite and cliftonite, the latter containing minute glassy grains

of a hardness above that of the ruby and believed by Huntington to be diamonds. Chemical composition as given is:

	Per cent.
Iron (Fe)-----	91.50
Nickel (Ni)-----	7.02
Cobalt (Co)-----	0.62
Copper (Cu)-----	Trace.
Phosphorus (P)-----	0.18
	<hr/> 99.32

*Reference.*—O. W. Huntington, The Smithville meteoric iron. Proc. Amer. Acad. Arts and Sci., vol. 29, 1893–94, p. 251.

**SOKO-BANJA (SARBANOVAC), NEAR BELGRADE, SERBIA. Nos. 41, 303.**

Stone, Cc. Weight, 220 grams; fragments with crust; a gray stone of uneven texture and evident fragmental structure. Fell October 13, 1877, at about 2 p. m., with the usual detonations and light effects. A shower of many stones, estimated to weigh from 48 to 80 kilograms, the largest of which weighed 23 *oka* (1,250 grams ?). Some 40,329 grams from this fall are now represented in 52 collections, public and private, three stones, weighing, respectively, 16,285 grams, 9,695 grams, and 254 grams, being in the museums of Belgrade. An analysis by Losanitch yielded:

	Per cent.
Silica (SiO <sub>2</sub> )-----	40.14
Ferrous oxide (FeO)-----	25.54
Magnesia (MgO)-----	25.78
Manganous oxide (MnO)-----	0.012
Soda (Na <sub>2</sub> O)-----	0.28
Potash (K <sub>2</sub> O)-----	0.06
Iron (Fe)-----	5.82
Nickel (Ni)-----	0.92
Cobalt (Co)-----	0.07
Sulphur (S)-----	1.46
Chromite-----	0.04
	<hr/> 100.102

The stone is described by Döll and Meunier as clastic and consisting of olivine, some enstatite, pyrrhotite, and nickel-iron.

*References.*—E. Döll, Verh. k. k. geol. Reichsanst., 1877, p. 283. S. Meunier, Compt. Rend., vol. 92, 1881, p. 331.

**STANNERN, NEAR IGLAU, MORAVIA, AUSTRIA. Nos. 94, 141.**

Stone, Eu. Weight, 47 grams. In two pieces; fragment with crust, weighing 14 grams, and a nearly complete individual, weighing 33 grams. Crust shining black, showing lines of flow. Fell

May 22, 1808, at 6 a. m. Some 200 to 300 individuals fell, strewed over an area some 8 by 3 miles, and estimated to weigh 52 kilograms. Chemical analyses by Rammelsberg yielded:

Constituents.	A. 34.96 per cent soluble in HCl.	B. 65.02 per cent insoluble.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica ( $\text{SiO}_2$ ).....	46.19	49.44
Alumina ( $\text{Al}_2\text{O}_3$ ).....	31.26	2.64
Iron oxide.....	2.93	23.31
Manganese oxide.....		1.25
Lime ( $\text{CaO}$ ).....	16.98	8.20
Magnesia ( $\text{MgO}$ ).....	1.12	9.97
Soda ( $\text{Na}_2\text{O}$ ).....	1.14	.35
Potash ( $\text{K}_2\text{O}$ ).....	.60	.10
Chromite.....		.83
	100.12	101.00

Later analysis by J. E. Whitfield, made with especial reference to the possible occurrence of barium, strontium, and zirconium, yielded:

	<i>Per cent.</i>
Silica ( $\text{SiO}_2$ ).....	47.94
Alumina ( $\text{Al}_2\text{O}_3$ ).....	11.19
Titanium oxide.....	.41
Zirconium oxide ( $\text{ZrO}_2$ ).....	None.
Phosphoric acid ( $\text{P}_2\text{O}_5$ ).....	.14
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....	.35
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ).....	1.20
Ferrous oxide ( $\text{FeO}$ ).....	18.97
Barium oxide ( $\text{BaO}$ ).....	None.
Strontium oxide ( $\text{SrO}$ ).....	None.
Nickel oxide ( $\text{NiO}$ ).....	.25
Cobalt oxide ( $\text{CoO}$ ).....	Trace.
Ferrous sulphide ( $\text{FeS}$ ).....	.86
Lime ( $\text{CaO}$ ).....	10.36
Magnesia ( $\text{MgO}$ ).....	7.14
Soda ( $\text{Na}_2\text{O}$ ).....	.75
Potash ( $\text{K}_2\text{O}$ ).....	.13
Water (above $104^\circ \text{C.}$ ) ( $\text{H}_2\text{O}$ ).....	.30
	<hr/> 99.99

The mineral nature and structure of the stone has been described by Tschermak, who found it a somewhat variable admixture of fragmentary matter, consisting mainly of the silicates anorthite and augite, with small, colorless, weakly refracting particles of an undetermined nature; in addition, nickel-iron, pyrrhotite and chromite.

*References.*—C. Rammelsberg, *Pogg. Ann.*, vol. 83, 1851, p. 592. G. Tschermak, *Min. pet. Mitth.*, 1872, p. 83. G. P. Merrill, *Mem. Nat. Acad. Sci.*, vol. 14, 1916, p. 17.

## STAUNTON, AUGUSTA COUNTY, VIRGINIA. Nos. 68, 69.

Iron, Om. Weight, 145 grams. From a mass found in 1858 and described by Mallet in 1871; a rectangular slab, etched, and showing coarse Widmanstätten figures, with scattering grains of troilite; also small mass weighing 9.86 grams found in 1887 and described by G. F. Kunz in 1887. Date of fall unknown. Five masses of this iron, with an aggregate weight of 113,964 grams, were found between 1858 and 1887. Analyses of these masses as made (Nos. I, II, III, and V) by Mallet, and (No. IV) by Santos, yielded the results given below:

Constituents.	I	II	III	IV	V
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Iron (Fe).....	88.706	88.365	89.007	91.439	90.298
Nickel (Ni).....	10.163	10.242	9.964	7.559	8.848
Cobalt (Co).....	.396	.428	.387	.608	.486
Copper (Cu).....	.008	.004	.003	.021	.016
Tin (Sn).....	.002	.002	.003	Trace.	.006
Phosphorus (P).....	.341	.362	.375	.068	.243
Sulphur (S).....	.019	.008	.026	.018	.012
Chlorine (Cl).....	.003	.002	.004	Trace.	Trace.
Carbon (C).....	.172	.185	.122	.142	.177
Silica (SiO <sub>2</sub> ).....	.067	.061	.066	.108	.092
	99.872	99.659	99.947	99.963	100.172

Specific gravity at 15° 7.853, 7.855, 7.839, respectively.

Mallet also determined the amount and character of the gases yielded by these irons and found the following:

	<i>Per cent.</i>
Hydrogen .....	35.83
Carbonic oxide .....	38.33
Carbonic anhydride .....	9.75
Nitrogen .....	16.09
	100.00

*References.*—J. W. Mallet, *Amer. Journ. Sci.*, vol. 2, 1871, p. 10; *Proc. Royal Soc. London*, vol. 20, 1872, p. 365.

## STAVROPOL, CAUCASUS, RUSSIA. No. 178.

Stone, Ck. Weight, 52.4 grams; fragment with crust; ground ash-gray and finely granular. Fell March 24, 1857. Original weight, 1,632 grams. Analyses by Abich yielded:

Constituents.	54.10 per cent soluble in HCl.	Constituents.	45.89 per cent insoluble in HCl.
Silica ( $\text{SiO}_2$ ).....	31.32	Silica ( $\text{SiO}_2$ ).....	47.44
Magnesia ( $\text{MgO}$ ).....	24.43	Alumina ( $\text{Al}_2\text{O}_3$ ).....	9.97
Ferrous oxide ( $\text{FeO}$ ).....	27.95	Ferrous oxide ( $\text{FeO}$ ).....	10.72
Iron ( $\text{Fe}$ ).....	4.37	Magnesia ( $\text{MgO}$ ).....	21.33
Nickel ( $\text{NiO}$ ).....	.85	Lime ( $\text{CaO}$ ).....	5.10
Alkalies ( $\text{K}_2\text{O} + \text{Na}_2\text{O}$ ).....	.50	Soda ( $\text{Na}_2\text{O}$ ).....	2.18
Sulphur ( $\text{S}$ ).....	1.64	Potash ( $\text{K}_2\text{O}$ ).....	.97
Tin oxide ( $\text{SnO}_2$ ).....	Traces.	Nickel oxide ( $\text{NiO}$ ).....	1.21
		Loss.....	1.06
	100.55		100.00

## Bulk analyses yielded:

	Per cent.
Silica ( $\text{SiO}_2$ ).....	33.16
Alumina ( $\text{Al}_2\text{O}_3$ ).....	4.22
Magnesia ( $\text{MgO}$ ).....	29.24
Lime ( $\text{CaO}$ ).....	1.20
Ferrous oxide ( $\text{FeO}$ ).....	18.59
Nickel oxide ( $\text{NiO}$ ).....	3.81
Tin oxide ( $\text{SnO}_2$ ).....	1.10
Iron ( $\text{Fe}$ ).....	4.32
Soda ( $\text{Na}_2\text{O}$ ).....	1.40
Sulphur ( $\text{S}$ ).....	1.60
Potash ( $\text{K}_2\text{O}$ ).....	0.60
Chlorine ( $\text{Cl}$ ) and loss.....	0.76
	100.00

The mineral nature, as calculated from the above, is given as:

	Per cent.
Hyalosiderite.....	45.65
Olivine.....	23.04
Labradorite.....	18.13
Pyrrhotite.....	2.95
Nickel-iron.....	10.25
	100.02

Gift of R. de Krutschoff.

*Reference.*—H. Abich, Bull. Acad. Imp. Sci. St. Petersburg, vol. 2, 1860, p. 403.

STEINBACH (BREITENBACH, RITTERSGRÜN) SAXONY, GERMANY. Nos. 2, 90, 140, 484.

Stony-iron, Siderophyre. Four pieces, weight, 124.7 grams. (1) Rittersgrün, found in 1847; section with crust, weighing 38 grams, and irregular slice weighing 31 grams. The stony portion exceeds the metallic, which consists of nickel-iron and one small mass of troilite. (2) Fragment weighing 2 grams, from Steinbach.

(3) One from Breitenbach, weighing 53.7 grams. The three localities mentioned are but about 1 mile apart, and the stones regarded as part of one and the same fall. Date of fall unknown—perhaps 1540. The Steinbach sample found previous to 1751; that of Rittersgrün in 1847; and that of Breitenbach in 1861.

The chemical and mineralogical composition of the Rittersgrün material has been investigated by Weisbach and by Winkler. According to the latter, the mineral composition and its relative proportions are as follows:

	Per cent.
Metallic portion, 51.031 per cent-----	Nickel iron ( $\text{Fe}_3\text{Ni}$ )----- 50.406
	Phosphor-nickel-iron ( $\text{FeNi}_2\text{P}$ )----- .149
	Phosphide of iron ( $\text{Fe}_3\text{P}$ )----- .274
	Silicide of iron ( $\text{Fe}_3\text{Si}$ )----- .169
	Sulphide of iron ( $\text{FeS}$ )----- .015
	Carbide of iron----- Trace.
Nonmetallic portion, 48.969 per cent-----	Copper----- .018
	Troilite----- 7.211
	Asmanite----- 8.527
	Bronzite----- 32.908
	Chromite----- .323

Analyses of the troilite, asmanite, nickel-iron, and the bronzite are also given. It was in this meteorite that the English mineralogist Maskelyne found the rhombic form of silica to which he gave the name *Asmanite*.

*References.*—N. Story-Maskelyne, Proc. Royal Soc. London, vol. 17, 1869, p. 370; vol. 19, 1871, p. 266; Philos. Trans., vol. 161, 1871, pp. 161 and 212. A. Weisbach, Verh. k. Berg-akad.; Verh. naturh. Ver. Bonn, vol. 33, 1876, p. 92. C. Winkler, Nova Acta k. Leop. Karol. Akad., vol. 40, 1878, p. 333.

**TADJERA, SETIF, CONSTANTINE, ALGERIA. No. 296.**

Stone, Ct. Fragment from interior, weighing 75 grams, from one of two masses, weighing 8,843 grams, which fell on June 9, 1867. Meunier described the stone as consisting of:

	Per cent.
Soluble silicates (mainly olivine)-----	50.40
Insoluble silicates (mainly pyroxene)-----	33.08
Chrome-iron -----	.20
Troilite -----	8.04
Nickel-iron -----	8.32
	100.04

*Reference.*—Daubree, Compt. Rend., vol. 66, 1868, p. 513.

**TAKEWELL, CLATSOP COUNTY, TENNESSEE. No. 53.**

Iron, Off. Weight, 152 grams. Date of fall unknown: found in 1853. Weight of original mass, 25 kilograms (55 pounds), according





1



2

VIEW OF (1) THOMSON STONE AND (2) ETCHED SLICE OF TOLUCA IRON.

FOR DESCRIPTIONS SEE PAGES 157 AND 159.

to J. Lawrence Smith. Smith's examination showed this meteorite to consist mainly of nickel-iron with troilite, schreibersite, a few scattered grains of olivine, and lawrencite (iron chloride). Duplicate analyses yielded:

	Per cent.	Per cent.
Iron (Fe).....	82.39	83.02
Nickel (Ni).....	15.02	14.62
Cobalt (Co).....	.43	.50
Copper (Cu).....	.09	.06
Phosphorus (P).....	.16	.19
Chlorine (Cl).....	----	.02
Sulphur (S).....	----	.08
Silica (SiO <sub>2</sub> ).....	.46	.84
Magnesia (MgO).....	----	.24
	98.55	99.57

Analyses are given also of the schreibersite.

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 19, 1855, p. 121.

TEHWASILM, ESTHLAND, RUSSIA. Nos. 83, 463.

Stone, Cca. Two pieces weighing 48 and 990 grams, with papillated, somewhat blebby crust. Groundmass dark ash-gray and coarsely granular. Fell June 28, 1872, at midday. Originally seven pieces, weighing 28.5 kilograms. Analysis by Schilling showed:

	Per cent.
Soluble in dilute hydrochloric acid.....	42.317
Insoluble in dilute hydrochloric acid.....	57.683

Bulk or mass composition:

Silica (SiO <sub>2</sub> ).....	38.91
Magnesia (MgO).....	22.261
Lime (CaO).....	1.374
Iron protoxide (FeO).....	17.531
Nickel (Ni).....	1.675
Iron (Fe).....	11.767
Phosphorus (P).....	.073
Alumina (Al <sub>2</sub> O <sub>3</sub> ).....	2.551
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ).....	.920
Alkalies (K <sub>2</sub> O, Na <sub>2</sub> O).....	2.236
Sulphur (S).....	.625
	99.923

The mineral composition was found to be olivine, bronzite, labradorite, nickel-iron, and troilite.

*Reference.*—G. Baron Schilling, Archiv. Naturk. Liv.-Ehst.- u. Kurlands, vol. 9, Heft 2, 1882, p. 95.

THOMSON, McDUFFIE COUNTY, GEORGIA. No. 395.

Stone, Cca. Weight, 218 grams. Nearly complete individual, constituting so far as known the entire fall (pl. 35). Found in 1888.

Nothing known regarding fall. A compact, distinctly chondritic stone belonging to class of veined chondrites. Mineral composition, olivine and pyroxenes with small areas of maskelynite and the usual metallic and sulphide particles. No chemical analyses have been made.

*Reference.*—G. P. Merrill, Smithsonian Misc. Coll., vol. 52, 1909, p. 473.

THUNDA, WINDORAH, QUEENSLAND, AUSTRALIA. No. 446.

Iron, Om. Slice about 45 by 45 mm., weighing 118 grams, from a mass weighing about 9,287 grams, found in 1886. Cohen gives the composition as follows:

	Per cent.
Iron (Fe) .....	91.54
Nickel (Ni) .....	8.49
Cobalt (Co) .....	.56
Copper (Cu) .....	.02
Sulphur (S) .....	.02
Phosphorus (P) .....	.17
Chromite .....	.01
	<hr/>
	100.81

From this he calculated the mineral composition to be as follows:

	Per cent.
Nickel-iron .....	98.85
Schreibersite .....	1.09
Troilite .....	.05
Chromite .....	.01
	<hr/>
	100.00

*Reference.*—E. Cohen, *Meteoreisen-Studien* 11, Ann. k. k. Naturhist. Hofmus., vol. 15, 1900, p. 381.

TIMOSCHIN, JUCHNOW, SMOLENSK, RUSSIA. No. 174.

Stone, Cc. Weight, 6.8 gr.; fragment from interior. Fell March 25, 1807. Weight of original mass 40 kilograms. Fall accompanied by the usual thunder-like detonations. Groundmass light ash-gray with rust spots, and showing dark green to brown kugels. Metallic constituents scarcely visible to the unaided eye. Analyses (I) by Scheerer and (II) by Klaproth yielded:

Constituents.	I.	II.
	<i>Per cent.</i>	<i>Per cent.</i>
Silica ( $\text{SiO}_2$ ).....	39.00	38.00
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ).....	17.5	25.00
Alumina ( $\text{Al}_2\text{O}_3$ ).....		1.00
Magnesia ( $\text{MgO}$ ).....	20.00	14.25
Iron ( $\text{Fe}$ ).....	17.75	17.60
Nickel ( $\text{Ni}$ ).....	1.25	.40
Lime ( $\text{CaO}$ ).....		.75
Manganous oxide ( $\text{MnO}$ ).....		
Sulphur ( $\text{S}$ ).....	4.5	3.00
Chromium ( $\text{Cr}$ ).....		
Loss.....		
	100.00	100.00

Gift of R. de Kroutschoff.

*Reference.*—O. Buchner, *Die Meteoriten*, 1863, p. 21.

**TOLUCA (XIQUIPILCO), MEXICO.** Nos. 75, 304, 357, 396.

Iron, Om. Weight 33,610 grams. (1) Etched slice some 16 by 20 cm., weighing 840 grams, showing distinct Widmanstätten figures and irregular nodules of troilite (pl. 35); (2) two complete individuals weighing 530 and 735 grams, showing oxidized and pitted surfaces; (3) end of mass weighing 1,050 grams and showing two large troilite nodules; and (4) nearly complete individual weighing 28,458 grams, with slab cut from same weighing 1,997 grams. Date of fall unknown. Known as early as 1776. Numerous masses of meteoric iron, varying in weight from 300 pounds to minute specimens, have been found in the Toluca Valley, and it is highly probable that they all came from the vicinity of Xiquipilco, in the State of Mexico. Many of these masses were used by the native blacksmiths as anvils and for making agricultural implements.<sup>1</sup> The iron is described by Cohen and Weinschenk as consisting of:

	<i>Per cent.</i>
Nickel-iron.....	95.05
Taenite.....	2.45
Schreibersite and rhabdite.....	1.17
Kamacite (?).....	.98
Nonmagnetic residue.....	.35
	100.00

The nonmagnetic residue contained siliceous particles, among which orthoclase, plagioclase, feldspar, quartz, zircon, and pyroxene have been determined, with possibly garnet and cordierite. Chromite, apatite, and graphite were also found. This is the first meteoric iron in which the presence of quartz crystals and apatite were proven.<sup>2</sup>

<sup>1</sup> Eastman, *The Mexican meteorite*, Bull. Philos. Soc. Washington, vol. 12, March, 1892.

<sup>2</sup> It may be added that there is doubt concerning the occurrence of the quartz as an original constituent.

*References.*—For full bibliography, which includes a large number of titles, see Wülfing, pp. 357–360. Especial references, Cohen and Weinschenk, Ann. k. k. Naturhist. Hofmus., vol. 6, 1891, pp. 135–142. H. Laspeyres and E. Kaiser, Zeitschr. für Kryst. u. Min., vol. 24, 1895, pp. 485–493; vol. 27, 1896–97, p. 586.

**TOMBIGBEE RIVER, CHOCTAW COUNTY, ALABAMA. No. 252.**

Iron, Ha. Weight 2,954 grams. Slice some 11 by 18 by 4 cm., showing original and polished surface, the latter etched, showing a granular structure and large schreibersite inclosures (see pl. 36). Described in 1899. Originally six masses, weighing all together 53,795 grams. The slice in this collection is from mass No. 3 described by Foote, the original weight of which was 9,125 grams. This was found in 1886 on a hill in the southwest quarter of section 4, range 2 west, township 14, Choctaw County. Analysis by Whitfield on sample No. 5 yielded:

	Per cent.
Iron (Fe)-----	95.02
Nickel (Ni)-----	4.11
Cobalt (Co)-----	.40
Phosphorus (P)-----	.324
Carbon (C)-----	.161
Sulphur (S)-----	Trace.
	<hr/> 100.015

*Reference.*—W. M. Foote, Amer. Journ. Sci., vol. 8, 1899, pp. 153–156.

**TOMHANNOCK CREEK, RENSSELAER COUNTY, NEW YORK. No. 23.**

Stone, Cgb. Twenty-two grams from a mass weighing about 1.5 kilograms found in 1863.

**TONGANOXIE, LEAVENWORTH COUNTY, KANSAS. No. 253.**

Iron, Om. Weight 195 grams. Polished slab 13.5 by 8 cm. with etched surface showing Widmanstätten figures. Date of fall unknown. Found in 1886. Original weight 11.8 kilograms (26 pounds).

It has the following composition:

	Per cent.
Iron (Fe)-----	91.18
Nickel (Ni)-----	7.93
Cobalt (Co)-----	.39
Phosphorus (P)-----	.10
Copper (Cu)-----	Trace.
	<hr/> 99.60

Specific gravity, 7.45.

*Reference.*—E. H. S. Bailey, Amer. Journ. Sci., vol. 42, 1891, p. 385.

## TOYAH, REEVES COUNTY, TEXAS. No. 441.

Iron. Weight 28 grams. Locality uncertain. Undescribed.

## TRAVIS COUNTY, TEXAS. No. 145.

Stone, Ckb. Weight 2,650 grams. Nearly complete mass with surface much oxidized. Interior nearly black and stained by iron rust. Found 1889; date of fall unknown. Composition as shown by L. G. Eakins's analysis:

	Per cent.
Silica ( $\text{SiO}_2$ ).....	44.75
Alumina ( $\text{Al}_2\text{O}_3$ ).....	2.72
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....	.52
Copper (Cu).....	Trace.
Ferrous oxide ( $\text{FeO}$ ).....	16.04
Iron (Fe).....	1.83
Nickel oxide ( $\text{NiO}$ ).....	.52
Nickel (Ni).....	.22
Cobalt (Co).....	.01
Manganous oxide ( $\text{MnO}$ ).....	Trace.
Lime ( $\text{CaO}$ ).....	2.23
Magnesia ( $\text{MgO}$ ).....	27.93
Potash ( $\text{K}_2\text{O}$ ).....	.13
Soda ( $\text{Na}_2\text{O}$ ).....	1.13
Phosphoric acid ( $\text{P}_2\text{O}_5$ ).....	.41
Sulphur (S).....	1.83
Ignition ( $\text{H}_2\text{O}$ ).....	.84
	101.11
Less O for S.....	.92
	100.19

The soluble and insoluble silicate analyses yielded:

Constituents.	Soluble in HCl (trollite deducted).			Insoluble in HCl.		
	Analysis.	Calculated to 100 per cent.	Molecular ratios.	Analysis.	Calculated to 100 per cent.	Molecular ratios.
Silica ( $\text{SiO}_2$ ).....	15.67	38.13	0.636	30.36	56.14	0.936
Alumina ( $\text{Al}_2\text{O}_3$ ).....	1.06	2.58	.025	2.02	3.73	.036
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....				.54	1.00	.007
Ferrous oxide ( $\text{FeO}$ ).....	8.12	19.76	.274	4.95	9.15	.127
Nickel oxide ( $\text{NiO}$ ).....	.49	1.19	.016			
Lime ( $\text{CaO}$ ).....	.42	1.02	.018	1.94	3.59	.064
Magnesia ( $\text{MgO}$ ).....	15.34	37.32	.933	13.23	24.44	.611
Potash ( $\text{K}_2\text{O}$ ).....	Undet.			.10	.19	.002
Soda ( $\text{Na}_2\text{O}$ ).....	Undet.			.95	1.76	.028
	41.10	100.00	.....	54.08	100.00	.....

The strictly metallic portion yielded:

	Per cent.
Iron (Fe).....	88.74
Nickel (Ni).....	10.68
Cobalt (Co).....	.58
	<hr/> 100.00

From these analyses the proportional mineral composition is calculated as:

	Per cent.
Nickelliferous iron.....	2.23
Troilite.....	5.03
Sol. in HCl (mainly olivine).....	39.84
Insol. in HCl (mainly enstatite with a little chromite and feldspar).....	52.42
	<hr/> 99.52

Structure indistinctly chondritic, firm, and compact; iron scarcely visible to the naked eye. Wülfing suggests that this may belong to the same fall as the Bluff, Fayette County, stone. The general appearance, color, relative portion of the constituents, and chemical composition are, however, all against this.

Gift of R. T. Hill.

*Reference.*—L. G. Eakins, A new stone meteorite. *Amer. Journ. Sci.*, vol. 39, 1890, pp. 59–61.

**TRENTON, WASHINGTON COUNTY, WISCONSIN. No. 65.**

Iron, Om. Weight 327 grams. Section 8.3 by 7 by 1.5 cm. etched and showing Widmanstätten figures and large troilite nodule. Date of fall unknown; found in 1858. Originally six masses weighing 65 kilograms, four being found in 1858, one in 1869, and one in 1871. Chemical composition as given by J. Lawrence Smith:

	Per cent.
Iron (Fe).....	91.03
Nickel (Ni).....	7.20
Cobalt (Co).....	.53
Phosphorus (P).....	.14
Copper (Cu).....	Trace.
Insol. residue.....	.45
	<hr/> 99.35

The iron is octahedral in structure, but shows on an etched surface peculiar rectangular markings to which Smith proposed to give the name *Laphamite*.

*References.*—J. L. Smith, *Amer. Journ. Sci.*, vol. 47, 1869, p. 271. I. A. Lapham, *Amer. Journ. Sci.*, vol. 3, 1872, p. 69.

**TREZZANO, LOMBARDY, ITALY. No. 327.**

Stone, Cca. Fragment weighing 163 grams, from one of two stones weighing 882,459 grams, which fell on November 12, 1856. The mineral composition as quoted by Buchner is:

	Per cent.
Nickel-iron .....	22. 78
Trollite .....	4. 96
Iron magnesian silicates.....	71. 88
	<hr/> 99. 62

*Reference.*—O. Buchner, *Die Meteoriten in Sammlungen*, 1863, p. 90.

**TUCSON, ARIZONA: THE SIGNET, IRWIN, OR RING METEORITE. No. 368.**

Iron, Dm. Weight of main mass 621,531 grams. Original mass stated to have weighed 637,224 grams. In form of a complete ring. Height, 97 centimeters; greatest width, 124 centimeters; width of opening, 68 centimeters; greatest thickness of ring, 49 centimeters; least thickness, 4.5 centimeters. (See pl. 1.) Date of fall unknown. First called to public attention by Dr. John L. LeConte in 1851,<sup>1</sup> and brought to the Smithsonian Institution in 1863, through the influence of Dr. B. J. D. Irwin, U. S. A. The original source is believed to have been the Pass of Los Muchachos, in the Sierra de la Madera, whence it was brought by Spanish soldiers to the old Presidio, where it remained until the withdrawal of the Spanish garrison. It was then taken to Tucson and set up as a kind of "public anvil for the use of the inhabitants." The mass was sent in 1860 from Tucson to Hermosillo, and later to Guaymas. In 1863 it was taken to San Francisco and thence to Washington by way of the Isthmus of Panama.

The results of chemical analyses obtained by various investigators are somewhat variable, as might be anticipated from material not absolutely homogeneous. The following are the results obtained by J. L. Smith, F. A. Genth, and G. J. Brush:

Constituents.	Smith.	Genth.		Brush.
	Per cent.	Per cent.	Per cent.	Per cent.
Iron (Fe) .....	85. 54	83. 47	83. 64	81. 65
Nickel (Ni) .....	8. 55	9. 44	9. 85	9. 17
Cobalt (Co) .....	. 61	. 42	.....	. 44
Copper (Cu) .....	. 03	. 008	(?)	. 08
Phosphorus (P) .....	. 12	. 10	. 15	. 49
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	Trace.	Trace.	Trace.	Trace.
Lime (CaO) .....	.....	. 46	(?)	1. 16
Magnesia (MgO) .....	2. 04	2. 59	2. 15	2. 43
Soda (Na <sub>2</sub> O) .....	.....	(?)	. 174	.....
Potash (K <sub>2</sub> O) .....	.....	(?)	. 008	.....
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> ) .....	. 21	(?)	. 50	.....
Silica (SiO <sub>2</sub> ) .....	3. 02	2. 87	.....	3. 63
Labradorite (?) .....	.....	1. 05	4. 17	.....
	100. 12	100. 408	100. 732	99. 06

<sup>1</sup> Proc. Amer. Assoc. Adv. Sci., Albany meeting, 1851, p. 188.

<sup>2</sup> Not estimated.

The composition of the strictly metallic portion is given as:

	Per cent.
Iron (Fe).....	89.89
Nickel (Ni).....	9.58
Cobalt (Co).....	.49
Copper (Cu).....	.04

100.00

The mineralogical composition as given by the authorities quoted is:

Constituents.	Smith.	Genth.	Brush.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Nickel-iron.....	90.64	90.03	86.24
Olivine.....	8.29	8.60	10.05
Schreibersite.....	.77	.64	3.18
Chromite.....	.30	.73	.53
	100.00	100.00	100.00

Subsequent<sup>1</sup> investigations by Cohen yielded results as below:

	Per cent.
Iron (Fe).....	84.60
Nickel (Ni).....	9.24
Cobalt (Co).....	.95
Copper (Cu).....	.02
Chromium (Cr).....	.02
Carbon (C).....	.04
Sulphur (S).....	.01
(Ce) <sup>2</sup> .....	.04
Phosphorus (P).....	.17
Silica (SiO <sub>2</sub> ).....	1.76
Magnesia (MgO).....	.51
Olivine residue.....	3.39

100.75

The olivine yielded:

Silica (SiO <sub>2</sub> ).....	44.91
Ferrous oxide (FeO).....	2.08
Lime (CaO).....	1.33
Magnesia (MgO).....	51.44

99.76

Specific gravity, according to Shepard, 6.66; to Smith, 6.52, 6.91, and 7.13; Brush, 7.29.

The mass is not a homogeneous iron, as it appears on casual inspection, but contains many minute, sometimes microscopic inclosures of olivine, as indicated in the analyses given above. No Widmanstätten figures are brought out by etching, as is common in

<sup>1</sup> Festschrift zu der 50 jährigen Doctor-Jubelfeier d. Herrn H. Lämprich, Greifswald, 1900, pp. 27-73. Abstract in Neues Jahrbuch, 1901, No. 2, p. 37.

<sup>2</sup> Probably a typographical error and should be Cl.

meteoric irons, the surface becoming covered only with "an irregular net work of yellow metallic lines resembling troilite or schreibersite," and round each inclosure, large or small, may be seen a linear margin of the same material. This is shown somewhat indistinctly on the polished surface on the inner part of the ring, and in the small sample (No. 40) in the Shepard collection.

Through misunderstandings a controversy arose as to whom was entitled the credit of securing this unusually interesting relic for the national collections. The matter seems to have been settled in Doctor Irwin's favor in the publication mentioned below.

*References.*—L. Fletcher, The meteoric iron of Tucson, Min. Mag., vol. 9, 1890, p. 16. B. J. D. Irwin, History of the Great Tucson Meteorite, etc., 1865 (privately printed).

**UEERABA, MINAS GERAES, BRAZIL. No. 363.**

Stone, Cka. Forty-gram fragment from a shower aggregating some 30–40 kilograms which fell on June 29, 1903.

*Reference.*—E. Hussak, Ann. k. k. Naturhist. Hofmus., 1904.

**UTRECHT, HOLLAND. No. 85.**

Stone, Cca or Cc. Weight, 28.7 grams, of which 25.9 grams are in form of coarse powder. Fell June 2, 1843, at 8 p. m. Two stones fell; the first, weighing 7 kilograms, buried itself to a depth of 1 meter (39 inches) in the earth. It was quite cold when removed a quarter of an hour later. The second, weighing 2.7 kilograms, was not found until three days later. The stone is described as clear gray, nearly white with iron granules, and yellow and black, sometimes purple red points.

Analysis recalculated by Baumhauer yielded: Magnetic portion, 10.91; nonmagnetic, 89.09; specific gravity, 3.65.

The magnetic portion consists of nickel-iron. The nonmagnetic portion was calculated by Baumhauer to consists of pyrrhotite, olivine, albite, and augite. A bulk analysis (recalculated) yielded:

	Per cent.
Silica ( $\text{SiO}_2$ )	39.30
Alumina ( $\text{Al}_2\text{O}_3$ )	2.25
Iron (Fe)	11.07
Ferrous oxide ( $\text{FeO}$ )	15.29
Lime ( $\text{CaO}$ )	1.48
Magnesia ( $\text{MgO}$ )	24.37
Soda ( $\text{Na}_2\text{O}$ )	1.39
Potash ( $\text{K}_2\text{O}$ )	.15
Chromic oxide and ferrous oxide ( $\text{Cr}_2\text{O}_3 + \text{FeO}$ )	.65
Nickel (Ni) and cobalt (Co)	1.24
Sulphur (S)	1.90
Phosphorus (P)	.005
Copper (Cu) and tin (Sn)	.025
	<hr/> 99.120

*Reference.*—E. H. von. Baumhauer, Pogg. Ann., vol. 66, 1845, p. 465.

VACA MUERTA (SIERRA DE CHACO), ATACAMA, CHILE. No. 1.

Stony-iron, Grahamite. Weight, 432 grams; roughly cubical mass with portion of original surface. Date of fall unknown; found prior to 1862. The Museum sample was received from the University of Santiago, labeled as found in 1862, and is probably from the sample described by Professor Domeyko.<sup>1</sup> The composition of the metallic and silicate portions of this, as given by Domeyko, is:

Metallic:	Per cent.
Iron (Fe) .....	88.6
Nickel (Ni) .....	11.4
	<hr/>
	100.00
Silicate:	
Silica (SiO <sub>2</sub> ) .....	43.22
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	7.60
Ferrous oxide (FeO) .....	26.52
Magnesia (MgO) .....	6.60
Lime (CaO) .....	4.27
Soda (Na <sub>2</sub> O) .....	.40
Sulphur (S) .....	4.34
Iron (Fe) .....	7.50
	<hr/>
	100.45

The mineral composition of the Sierra de Chaco stone, which is considered the same, is given as nickel-iron, pyrrhotite, olivine, enstatite, augite, and plagioclase. For the Mejillones iron Domeyko gives the following composition:

	Per cent.
Iron .....	95.4
Nickel .....	3.8
Cobalt .....	.1
Schreibersite .....	.9
	<hr/>
	100.2

Gift of the University of Santiago, Chile.

*References.*—Domeyko, Compt. Rend., vol. 58, 1864, p. 551, and vol. 81, 1875, p. 599. L. Fletcher, Min. Mag., vol. 8, 1889, p. 223.

VERAMIN (KARAND), TENTRAN, PERSIA. Nos. 225, 410.

Stony-iron, Mesosiderite. Two pieces, weighing about 10 grams, from a mass weighing some 45 kilograms which fell in February, 1880.

*Reference.*—H. A. Ward, A trip after meteorites. The Mineral Collector, vol. 6, June, 1899, p. 59.

<sup>1</sup> Comptes Rendus, vol. 58, 1864, p. 551.

## VICTORIA (SASKATCHEWAN RIVER), BRITISH COLUMBIA. No. 417.

Iron, Om. Rectangular piece, 30 by 14 by 3 mm., weighing 13 grams, from a mass weighing 175 kilograms, found in 1871.

## VIGARANO PARISH, NEAR FERRARA, ITALY. No. 477.

Stone, Cc. A roughly cubical mass some 60 by 50 by 40 mm. with oxidized crust on two surfaces; dark gray with white spots. Weight, 297 grams, from a stone weighing 11.5 kilograms, or 25 pounds, which fell January 22, 1910. It is described by A. Rosati as a carbonaceous chondrite. It consists of olivine, rhombic pyroxene and iron, with iron sulphide, chromite, plagioclase, augite, glass, and carbonaceous matter.

*Reference.*—A. Rosati, Neues Jahrb. Min. Geol. Pal., vol. 1, 1912, p. 44 (abstract).

## VOUILLE, NEAR POITIERS, FRANCE. No. 404.

Stone, Cia. 11 grams from a mass weighing some 20 kilograms, which fell May 13, 1831.

## WACONDA, MITCHELL COUNTY, KANSAS. Nos. 61, 502.

Stone, Ccb. Fragment from interior weighing 112 grams, and two smaller weighing together 8 grams, one showing crust. Date of fall unknown; found in 1874, and about one-half carried away in fragments and lost; portion remaining weighing 58 pounds (26 kilograms). Analyses by Smith yielded:

	Per cent.
Stony matter .....	90.81
Nickel-iron .....	5.34
Troilite .....	3.85
	<hr/> 100.00

The nickel-iron yielded:

	Per cent.
Iron (Fe) .....	86.18
Nickel (Ni) .....	12.02
Cobalt (Co) .....	.91
Copper (Cu) .....	.04
	<hr/> 99.15

The stony portion yielded:

Constituents.	Soluble, 69 per cent.	Insoluble, 41 per cent.
Silica (SiO <sub>2</sub> ) .....	34.52	54.02
Ferrous oxide (FeO) .....	30.01	18.10
Magnesia (MgO) .....	32.50	23.45
Alumina (Al <sub>2</sub> O <sub>3</sub> ) .....	.43	2.30
Manganese (Mn) .....	.61	.36
Alkalies .....	.89	1.58
Copper oxide (CuO) .....		Trace.
	<hr/> 98.96	<hr/> 99.81

The mineral composition as calculated from these analyses would then be: Nickel-iron, 5.34; troilite, 3.85; olivine and enstatite.

*References.*—C. U. Shepard, Amer. Journ. Sci., vol. 11, 1876, pp. 473-474. J. L. Smith, Amer. Journ. Sci., vol. 13, 1877, pp. 211-214; Original Researches, 1884, p. 523.

WALKER COUNTY, ALABAMA. No. 190.

Iron, H. A thin slice some 2 by 3 cm. in diameter, weighing 15 grams, from a mass weighing about 165 pounds, or 74.5 kilograms, found in 1832 in the northeast corner of Walker County. Excepting that this iron is hexahedral in crystallization, there is no apparent reason for including it in the Lime Creek, Claiborne find, several hundred miles to the southwest.

WARRENTON, WARREN COUNTY, MISSOURI. No. 42.

Stone, Cco. Weight, 11 grams; fragment from interior. A fine, somewhat loosely aggregated mass of a smoky blue-gray color. Fell January 3, 1877, at 7 a. m. No report nor luminous phenomena accompanied the fall, the only sound being that caused by its passage through the air, which was compared to the whistle of a distant locomotive or the passage of a cannon ball. Struck a tree in falling and portions of wood fibers adhered, which, however, were not in the least charred, indicating that the temperature was not high, though it was reported that the snow was melted immediately around the spot where it fell. Original weight estimated at 100 pounds (45.5 kilograms), but only some 10 or 15 pounds (4 to 7 kilograms) preserved. Passage of stone in its flight from northwest to southeast. Analyses by Smith yielded:

	Per cent.
Nickel-iron.....	2. 01
Troilite .....	3. 51
Silicates (including chromite).....	94. 48
	<hr/>
	100. 00

The metallic portion yielded:

	Per cent.
Iron (Fe).....	88. 51
Nickel (Ni) .....	10. 21
Cobalt (Co).....	. 60
	<hr/>
	99. 32

The silicate portion yielded:

Constituents.	Soluble, 80.40 per cent.	Insoluble, 19.60 per cent.
Silica ( $\text{SiO}_2$ ).....	33.02	56.90
Ferrous oxide ( $\text{FeO}$ ).....	37.57	10.20
Alumina ( $\text{Al}_2\text{O}_3$ ).....	.12	.20
Lime ( $\text{CaO}$ ).....	Trace.	7.92
Magnesia ( $\text{MgO}$ ).....	28.41	22.41
Soda ( $\text{Na}_2\text{O}$ ).....	.07	1.00
Nickel oxide ( $\text{NiO}$ ).....	1.54	.....
Cobalt oxide ( $\text{CoO}$ ).....	.31	.....
Chromic oxide ( $\text{Cr}_2\text{O}_3$ ).....	.....	.33
	101.04	98.66

The mineral composition as calculated from these analyses was:

	Per cent.
Olivine .....	76.00
Bronzite and pyroxene minerals.....	18.00
Nickel-iron .....	2.00
Troilite .....	3.50
Chromite .....	.50
	100.00

*Reference.*—J. L. Smith, Amer. Journ. Sci., vol. 14, 1877, pp. 219–299; Original Researches, 1884, p. 532.

WELLAND, ONTARIO, CANADA. No. 416.

Iron, Om. Fragment some 40 by 20 by 20 mm., weighing 38 grams, from a mass weighing 8 kilograms found in 1888. The chemical composition, as determined by J. M. Davison, is as follows: Iron, 91.17; nickel, 8.54; cobalt, 0.06; sulphur, 0.07.

*Reference.*—E. E. Howell, Proc. Rochester Acad. Sci., vol. 1, 1890, p. 86.

WESTON, FAIRFIELD COUNTY, CONNECTICUT. Nos. 126, 270, 406.

Stone, Ccb. Four fragments weighing 4, 6, 6, and 17 grams. All from the interior. Fell December 14, 1807, at 6.30 a. m. The fall was accompanied by the usual flash of light and detonations compared to the sound produced by cannon balls rolling over a floor. The meteor passed from the north toward the west and was in sight some 30 seconds. Six or seven masses were known to fall within a distance of some 9 or 10 miles along the line taken by the meteor, the aggregate weight of which has been estimated at about 330 pounds, or 150 kilograms. The largest individual is estimated to have weighed some 10 kilograms. The stone is chondritic, of ash-gray color, with metallic iron and pyrrhotite visible to the unaided eye. Analyses made by Professor Silliman are, owing to the condition of analytical science at that time, of only historical value. The

stone is of interest in being the first recorded and described meteoric stone to fall in America.

*Reference.*—B. Silliman and J. L. Kingsley, *Trans. Amer. Philos. Soc.*, vol. 6, 1809, p. 323.

WICHITA COUNTY (BRAZOS RIVER), TEXAS. Nos. 20, 342.

Irora, Og. Two slices, one 4 by 1 by 0.7 cm., weighing 20.8 grams, and one, 5 by 5 cm., weighing 143 grams. Date of fall uncertain; first known in 1836. Original weight unknown, but not far from 160 kilograms, as given by Mallet. Analysis by this authority yielded:

	Per cent.
Iron (Fe)-----	90.769
Nickel (Ni)-----	8.342
Cobalt (Co)-----	.205
Manganese (Mn)-----	Trace.
Copper (Cu)-----	.018
Tin (Sn)-----	.004
Phosphorus (P)-----	.141
Sulphur (S)-----	.016
Graphitic carbon (C)-----	.190
Silica (SiO <sub>2</sub> )-----	.132
Magnetic iron oxide}-----	
	99.877

Specific gravity at 24° C., 7.841.

It has been suggested that this iron may have been a part of the same fall as the Red River or Cross Timbers mass found about 1808.

*References.*—B. F. Shumard, *Trans. St. Louis Acad. Sci.*, vol. 1, 1856-60, p. 622. J. W. Mallet, *Amer. Journ. Sci.*, vol. 28, 1884, p. 285.

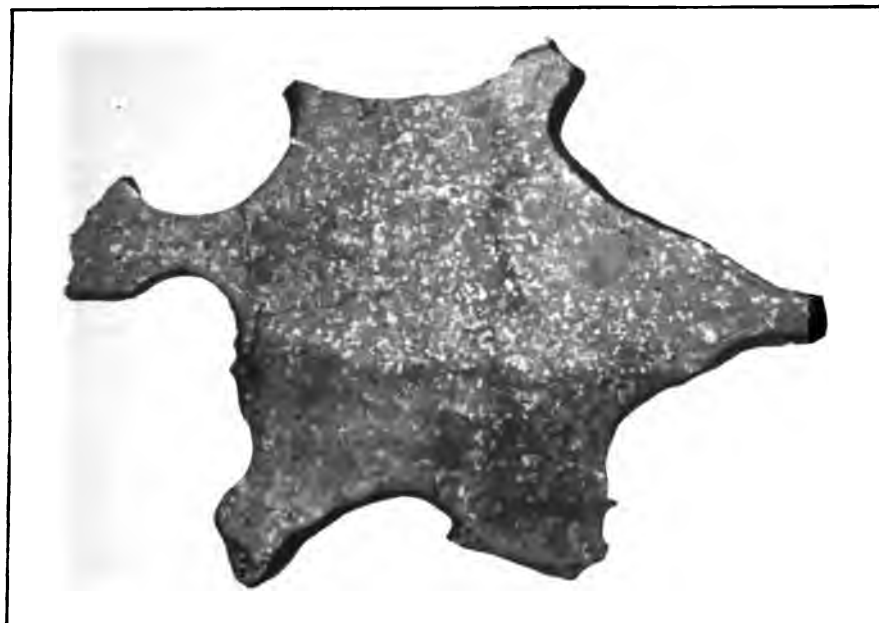
WILLAMETTE, CLACKAMAS COUNTY, OREGON. No. 500.

Iron, Om. An irregular slice 23 by 30 cm. in greatest diameter, weighing 1,954 grams, from the gigantic mass weighing 31,107 pounds, found in the autumn of 1902, and now in the American Museum of Natural History in New York. It is the third largest mass known. Its chemical composition as shown by Davison's analysis is:

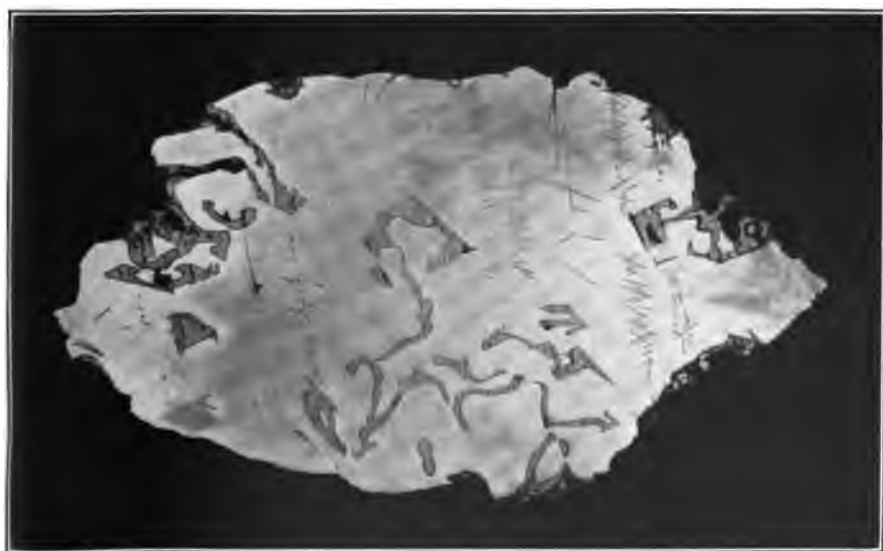
	Per cent.
Iron (Fe)-----	91.65
Nickel (Ni)-----	7.88
Cobalt (Co)-----	.21
Phosphorus (P)-----	.09
	99.83

Gift of C. S. Bement. (Pl. 36, fig. 1.)

*References.*—H. L. Ward, *Proc. Rochester Acad. Sci.*, vol. 4, 1904, p. 137. E. O. Hovey, *Amer. Mus. Journ.*, vol. 6, No. 3, July, 1906, p. 105.



1



2

ETCHED SLICE OF (1) WILLAMETTE IRON AND (2) OF TOMBIGBEE RIVER IRON.

FOR DESCRIPTIONS SEE PAGES 160 AND 170.





## WILLIAMSTOWN, KENTUCKY. Nos. 374, 377.

Iron, Om. Portion of end of mass, weighing 731 grams, and a slice 30 by 6 cm., weighing 555 grams. From a mass weighing 68 pounds, or 31 kilograms, found in April, 1892. The composition as shown by analysis by W. Tassin is:

	Per cent.
Iron (Fe) -----	91.54
Nickel (Ni) -----	7.28
Cobalt (Co) -----	.52
Copper (Cu) -----	.03
Chromium (Cr) -----	.05
Phosphorus (P) -----	.12
Sulphur (S) -----	.17
Carbon (C) -----	.004
Silicon (Si) -----	Trace
	<hr/> 99.694

*Reference.*—E. E. Howell, Amer. Journ. Sci., vol. 25, Jan., 1908, p. 49.

## YOUNDEGIN, 70 MILES EAST OF YORK, WEST AUSTRALIA. No. 458.

Iron, Og. Slice 6 by 6 cm., weighing 410 grams, from one of 4 masses weighing 73½ pounds, found in 1884. The composition as given by L. Fletcher is:

	Per cent.
Iron (Fe) -----	92.67
Nickel (Ni) -----	6.46
Cobalt (Co) -----	.55
Copper (Cu) -----	Trace
Magnesium (Mg) -----	.42
Phosphorus (P) -----	.24
Sulphur (S) -----	None
Insoluble cubes (Cliftonite) -----	.04
	<hr/> 100.38

The chief interest of this iron lies in the presence of crystals of a cubic form of carbon about 0.25 mm. in diameter, to which Dr. L. Fletcher gave the name *cliftonite*, in honor of Prof. R. B. Clifton, of Oxford University.

*Reference.*—L. Fletcher, Min. Mag., vol. 7, 1887, p. 121.

## ZABORZIKA, VOLHYNIA, RUSSIA. No. 180.

Stone, Cw. Weight, 4.1 grams; fragment from the interior. Light gray ground, fine, granular, and friable. Fell April 10, 1818. Original weight, 4 kilograms. A light gray stone with small rust spots and pyrrhotite and metallic iron scarcely visible to the unaided eye. Indistinctly chondritic. Laugier's analysis, published in 1823, sums up 109.4 and is obviously erroneous. He gives:

	Per cent.
Silica ( $\text{SiO}_2$ )	41.00
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	45.00
Alumina ( $\text{Al}_2\text{O}_3$ )	.75
Magnesia ( $\text{MgO}$ )	14.9
Lime ( $\text{CaO}$ )	2.00
Nickel (Ni)	1.00
Chromium (Cr)	.75
Sulphur (S)	4.00
	<hr/> 109.40

Gift of R. de Kroutschoff.

*Reference.*—Laugier, Gilbert's Annalen, vol. 75, 1823, p. 264.

ZACATECAS, MEXICO. No. 57.

Iron, Obz. Weight, 14.8 grams. Date of fall unknown; found in 1792. Original weight some 1,000 kilograms. According to Bergmann, as quoted by Buchner (p. 145), this iron consists of 93.77 nickel-iron, 2.27 pyrrhotite, 1.48 chromite, 1.65 schreibersite, and 0.49 carbon.

Gift of J. Berrien Lindsley.

DAVID, BOSNIA, AUSTRIA. No. 232.

Stone, Cia (?). Weight, 31 grams. Irregular fragment from the interior. Fell August 1, 1897, about 11.30 a. m. Four stones were reported. The largest, which was broken, was estimated to have weighed 90 kilos; the others weighed 2.542 kilograms, 220 grams, and 48 grams, respectively, a total of 92,810 grams. General direction of flight southeast to northwest. A moderately firm, indistinctly chondritic stone, of a light gray color, in which the metallic particles are so small as to be scarcely distinguishable by the unaided eye.

The mineral composition, according to Berwerth, is olivine, bronzite, a monoclinic pyroxene, a little plagioclase, chromite, pyrrhotite, and nickel-iron. Analyses by Carl Hödlmoser yielded:

	Per cent.
Ignition ( $\text{H}_2\text{O}$ )	0.39
Silica ( $\text{SiO}_2$ )	41.90
Alumina ( $\text{Al}_2\text{O}_3$ )	1.92
Iron (Fe)	.15
Ferrous oxide ( $\text{FeO}$ )	27.40
Cobalt (Co)	Trace.
Nickel (Ni)	Trace.
Manganese (Mn)	Trace.
Lime ( $\text{CaO}$ )	4.60
Magnesia ( $\text{MgO}$ )	22.79
Soda ( $\text{Na}_2\text{O}$ )	1.05
Potash ( $\text{K}_2\text{O}$ )	.41
Sulphur (S)	1.01
	<hr/> 101.62
Less O for S	.51
	<hr/> 101.11

Berwerth regards the stone as a tufaceous rock somewhat metamorphosed by heat.

*References.*—C. Hödlmoser, *Min. pet. Mitth.*, vol. 18, 1899, p. 513.  
F. Berwerth, *Wiss. Mitth. Bosnien u. der Hercegovina*, vol. 8, 1901, pp. 1-17; *Centralblatt für Min.*, No. 21, 1901, pp. 641-647.

#### CASTS OF METEORITES.

The collections contain casts in plaster of the meteorites listed below. The asterisk indicates also a mold from which additional casts may be made, for exchange purposes, if desired.

- Algoma, Kewaunee County, Wisconsin.
- Babb's Mill, Greene County, Tennessee.
- Bacubirito (Ranchito), Sinaloa, Mexico.
- Bath Furnace, Bath County, Kentucky.
- Beaver Creek, West Kootenai District, British Columbia.
- Braunau, Hauptmannsdorf, Bohemia.
- Cabin Creek, Johnson County, Arkansas.
- Cape York, Greenland. (3 casts.)
- Cross Roads, Boyett, Wilson County, North Carolina.
- \*Cullison, Pratt County, Kansas.
- Davidson County, North Carolina.
- El Capitan, New Mexico.
- Glorieta Mountain, Santa Fe County, New Mexico.
- Grand Rapids, Kent County, Michigan.
- \*Hendersonville, Henderson County, North Carolina.
- Kendall County, Texas.
- Kokstadt, Griqualand, South Africa.
- \*Mart, McLennan County, Texas.
- Mazapil, Mexico.
- \*\*Modoc, Kansas. (Casts of 2 largest stones.)
- Mount Joy, Adams County, Pennsylvania.
- Nedagolla, Madras, India.
- \*Perryville, Perry County, Missouri.
- Plymouth, Marshall County, Indiana.
- \*Rich Mountain, Jackson County, North Carolina.
- Rowton, Shropshire, England.
- \*Santa Rosa, Coahuila, Mexico.
- Sarepta, Saratov, Russia.
- Scottsville, Allen County, Kentucky.
- Steinbach, Saxony, Germany.
- \*Thomson, McDuffie County, Georgia.
- Wold Cottage, Yorkshire, England.





**PROFESSOR CHARLES UPHAM SHEPARD.**

Born, 1804; died, 1886.









SHEPARD COLLECTION OF METEORITES IN THE U. S. NATIONAL MUSEUM.

FOR DESCRIPTION SEE PAGE 175.

## B. THE SHEPARD COLLECTION.

Prof. C. U. Shepard, one of the earliest American mineralogists, was born June 29, 1804, and died May 1, 1886. For several years he served as an assistant to Prof. Benj. Silliman, sr., in Yale College, New Haven, Connecticut, and was professor of chemistry in the Medical College of the State of South Carolina, at Charleston, South Carolina, from 1833 to 1870, except during the period of the Civil War. For some years also he was professor of chemistry and natural history at Amherst College, in Massachusetts. He was one of the most enthusiastic American students of meteorites, wrote many papers relating to them, and made extensive collections. This collection is exhibited through the courtesy of his son, Dr. C. U. Shepard, of Summerville, South Carolina.<sup>1</sup>

### ABERT IRON. No. 80.

Iron, Om. Fragment weighing 11.3 grams. Source unknown.

### ALAIS, GARD, FRANCE. No. 133.

Stone, K. A dark brown powder and some friable fragments weighing 0.60 grams; carbonaceous. Fell March 15, 1806, 5 p. m.

### ALBARETO, NEAR MODENA, ITALY. No. 194.

Stone, Cc. Fragment from interior weighing 1 gram. Ground-mass light gray. Fell July, 1766.

### ALEXANDER COUNTY, NORTH CAROLINA. No. 82.

Iron. Etched fragment weighing 12.3 grams. Found in 1860.

### ALFIANELLO, PROVINCE OF BRESCIA, ITALY. No. 237.

Stone, Ci. Two fragments from interior weighing 29.54 grams. Fell February 16, 1883, 3 p. m.

### ALLEGAN, MICHIGAN. No. 247.

Stone, Cco. Fragments from interior weighing 125 grams.

---

<sup>1</sup> Dr. Shepard died on July 5, 1915, since the manuscript of this Bulletin went to the printer. By his will the collection has been left to the United States National Museum as a memorial of his father's labors.

ANGERS, MAINE-ET-LOIRE, FRANCE. No. 147.

Stone, Cwa. Fragments from interior weighing 0.72 gram. Fell June 3, 1882.

ASSAM, INDIA. No. 168.

Stone, Cgb. Dark ash gray fragment with crust, weighing 7 grams; gray chondrules. Found 1846.

ASSISI, NEAR PERUGIA, ITALY. No. 239.

Stone, Cc. Fragment with crust, weighing 29 grams; groundmass ash-gray, containing chondrules and metallic grains. Fell May 24, 1886.

AUBURN, LEE (FORMERLY MACON) COUNTY, ALABAMA. No. 76.

Iron, H. Eight fragments weighing 228.15 grams. Found in 1867.

AUGUSTINOWKA, EKATERINOSLAW, RUSSIA. No. 245.

Iron, Of. Three fragments: Two oxidized, weighing 50 grams and 24 grams, respectively, and one unoxidized, weighing 7 grams. Found in 1890.

AUMIERS, CANTON, MASSEGROS, LOZÈRE, FRANCE. No. 166.

Stone, Cwa. Fragment weighing 0.45 gram. Fell June 3, 1842.

AUSSEN (CLARAC), MONTRÉJEAU, HAUTE-GARONNE, FRANCE. No. 185.

Stone, Cc. Two fragments, one showing crust, weighing 20.1 grams. Groundmass ash gray flecked with rust and containing light and dark chondrules and metallic grains. Fell December 9, 1858.

BABB'S MILL, GREENE COUNTY, TENNESSEE, No. 34.

Iron, Db. (1) Small fragment; (2) vial of filings; (3) vial of turnings; total weight, 20.63 grams. Known in 1842.

BACHMUT (ALEXEJEWKA), EKATERINOSLAW, RUSSIA. No. 142.

Stone, Civ. Fragment with crust and polished surface, weighing 8.6 grams. Groundmass greenish gray with numerous metallic grains and chondrules. The metallic portion is more or less oxidized. Fell February 15, 1814.

BAIRD'S PLANTATION, ASHEVILLE, BUNCOMBE COUNTY, NORTH CAROLINA.  
No. 29.

Iron, Om. Three fragments, weighing 2.95 grams. Found in 1839.

**BALLINOO (10 MILES SOUTH OF), MURCHISON RIVER, WEST AUSTRALIA. No. 104.**

Iron, Of. Weight 122 grams. Etched surface has a stippled appearance, overlaid with a network of fine lines. Found in 1892.

**BANDONG, JAVA. No. 212.**

Stone, Cw. Fragment with pitted dull black crust, weighing 50.87 grams. Groundmass ash gray, containing chondrules; grains of nickel iron and troilite, some of them quite large. Fell December 10, 1871, 1.30 p. m.

**BARBOTAN, ROQUEFORT, LANDES, FRANCE. No. 126.**

Stone, Cga. Section showing crust; weight 28.7 grams. Groundmass light gray, and containing chondrules and numerous metallic grains. Fell July 24, 1790, 9 p. m.

**BEAR CREEK, DENVER COUNTY, COLORADO. No. 75.**

Iron, Of. (1) Section of mass showing troilite nodules, weighing 117.20 grams; (2) section with well-marked Widmanstätten figures and distinct plates of taenite, weighing 62.05 grams; (3) two vials of fragments showing octahedral cleavage. Found in 1866.

**BEMDEGO, MONTE SANTO, BAHIA, BRAZIL. No. 8.**

Iron, Og. Thin slab weighing 102 grams. Found in 1784.

**BENARES (KRAKHUT), INDIA. No. 131.**

Stone, Cc. Fragment with crust, weighing 7.32 grams. Polished surface shows chondrules and scattered metallic grains. Fell December 19, 1798.

**BISHOPVILLE, SUMTER COUNTY, SOUTH CAROLINA. No. 166.**

Stone, Chla. Weight, 1,090.4 grams. Mass with grayish vitreous crust; one vial of fragments. Fell March 25, 1843.

**BITBURG, PRUSSIA, GERMANY. No. 14.**

Stony-iron, Pallasite. Fragment weighing 19 grams. Found in 1807.

**BOHUMILITZ, BOHEMIA, AUSTRIA. No. 21.**

Iron, Og. Fragment with original surface, weighing 0.95 gram. One side etched to show Widmanstätten figures. Found in 1829.

**BONANZA, BOLSON DE MAPIMI, MEXICO. No. 27.**

Iron, H. Two etched fragments, weighing 238.6 grams. Found in 1837.

**BRANIE, MINSK, RUSSIA. No. 118**

Stony-iron, Pallasite. Fragment of iron matrix from which the stony matter has disappeared, weighing 5.13 grams. Found in 1810.

**BRAUNAU, HAUPTMANNSDORF, BOHEMIA. No. 45.**

Iron, H. Rectangular section containing troilite nodule; weight, 14.5 grams. Etched surface shows a network of fine lines. Fell July 14, 1847, 3.45 a. m.

**BRENHAM, KIOWA COUNTY, KANSAS. No. 120.**

Stony-iron, Pallasite. Weight, 430 grams. Polished slice showing a sponge-like metallic matrix, with olivine filling the cavities. Found in 1890.

**BURLINGTON, OTSEGO COUNTY, NEW YORK. No. 19.**

Iron, Om. Two pieces: Larger one, weighing 1,503.3 grams, shows original surface, one face etched; smaller one, weighing 25 grams, contains drill hole and is etched on three faces. Known prior to 1819.

**BUSTEE, INDIA. No. 176.**

Stone, Bu. Fragment, weighing 0.2 gram. Fell December 2, 1852.

**BUTLER, BATES COUNTY, MISSOURI. No. 86.**

Iron, Of. Weight, 391 grams. Section showing original surface. Etched face shows comb-like markings made up of fine lines; Widmanstätten figures very distinct. Minute nodules of troilite are scattered over the surfaces. Found in 1874.

**BUTSURA, GORUCKPUR, INDIA. No. 190.**

Stone, Ci. Fragment with crust and polished surface, weighing 7.83 grams. Metallic grains present in large amount; olivine chondrules 1 mm. in diameter. Fell May 12, 1861.

**CABEZA DE MAYO, MURCIA, SPAIN. No. 210.**

Stone, Civ. Fragment from interior, weighing 13.7 grams. Fell August 18, 1870.

**CAMBRIA (LOCKPORT), NIAGARA COUNTY, NEW YORK. No. 37.**

Iron, Of. Weight 33.2 grams. Etched slab containing large nodule of troilite; etch figures coarse and approximately square. Found in 1818 (?).

**CAMPO DEL PUCARA, ARGENTINA, SOUTH AMERICA. No. 112.**

Stony-iron, Pallasite. Fragment weighing 0.192 gram. Found in 1879.

**CAPE IRON, CAPE COLONY, SOUTH AFRICA. No. 10.**

Iron, Hca. Section, weighing 182.5 grams, showing portion of original surface and containing troilite nodule. Found in 1793.

**CARTHAGE, SMITH COUNTY, TENNESSEE. No. 96.**

Iron, Om. Section, weighing 43.1 grams, showing Widmanstätten figures, also delicate lines of taenite. Found in 1840.

**CASEY COUNTY, KENTUCKY. No. 89.**

Iron, Og. Fragment weighing 3.30 grams. Found in 1877.

**CASTINE, HANCOCK COUNTY, MAINE. No. 171.**

Stone, Cwa. Minute fragment with crust. Fell May 20, 1848.

**CHANDAKAPUR, BERAR, INDIA. No. 180.**

Stone, Cib or Cgb. Powder and angular fragments, weighing 1.05 grams. Fell June 6, 1838, 12 noon.

**CHANTONNAY, VENDÉE, FRANCE. No. 141.**

Stone, Cgb. Two fragments weighing 45.1 grams. Fell August 5, 1812, 2 a. m.

**CHARLOTTE, DICKSON COUNTY, TENNESSEE. No. 85.**

Iron, Of. Triangularly shaped section, weighing 2.70 grams. Fell in July or August, 1835.

**CHARSONVILLE, NEAR ORLEANS, LOIRET, FRANCE. (1) No. 138, (2) No. 150.**

Stone, Cga. (1) Fragment from interior, weighing 3.77 grams; (2) ("Bois de Fontaine") fragments and powder from interior, weighing 3.27 grams. Fell November 23, 1810, 1.30 p. m.

**CHATEAU-RENAUD, MONTARGIS, LOIRET, FRANCE. No. 162.**

Stone, Cia. Fragment from interior, weighing 3.74 grams. Groundmass ash gray, compact, and containing numerous metallic grains. Fell June 12, 1841.

**CHREMNITZ, SAXONY. No. 107.**

Iron. Part of a mass, perhaps Bitburg, weighing 75.27 grams. The iron has apparently been heated in a forge. Found in 1858.

**CHESTERTVILLE, CHESTER COUNTY, SOUTH CAROLINA. (1) No. 42, (2) No. 43.**

Iron, Hch. (1) An irregularly shaped section weighing 36.4 grams; etched surface shows a network of fine lines. (2) A rectangular section weighing 54.6 grams; etched surface as above. Found in 1847.

**CHILE, No. 74.**

Fragment consisting entirely of nickel-iron; weight, 4.76 grams.

**CHULAFINNEE, CLEBURNE COUNTY, ALABAMA. No. 84.**

Iron, Om. Thin slab, etched, weighing 54 grams. Widmanstätten figures broad and well outlined. Found in 1873.

**CLAIBORNE (LIME CREEK), MONROE COUNTY, ALABAMA. No. 94.**

Iron, H. Fragment weighing 3.7 grams. Found in 1834.

**CLAYWATER (VERNON COUNTY), WISCONSIN. No. 103.**

Stone, Cka. Polished slice, weighing 9.35 grams, made up of coarse, transparent, nonmetallic grains, with scattering grains of nickel-iron and chondrules, the whole resembling sandstone. Fell March 25, 1865.

**CLEVELAND (LEA IRON), EAST TENNESSEE. No. 98.**

Iron, Om. Weight 260 grams. Found in 1860.

**COAHUILA (SMITHSONIAN IRON), MEXICO. No. 94.**

Iron, H. Part of mass, weighing 88.3 grams. Etched surface shows cubic structure. Known in 1852.

**COLD BOKKEVELD, CAPE COLONY, SOUTH AFRICA. No. 100.**

Stone, K. Fragment of a dull black color flecked with white, weighing 9.27 grams. Fell October 13, 1838, 9 a. m.

**COOPERTOWN, ROBERTSON COUNTY, TENNESSEE. No. 67.**

Iron, Om. Weight, 327.83 grams. Two slices etched, showing Widmanstätten figures made up of broad plates 5 to 7 mm. in width. Known in 1860.

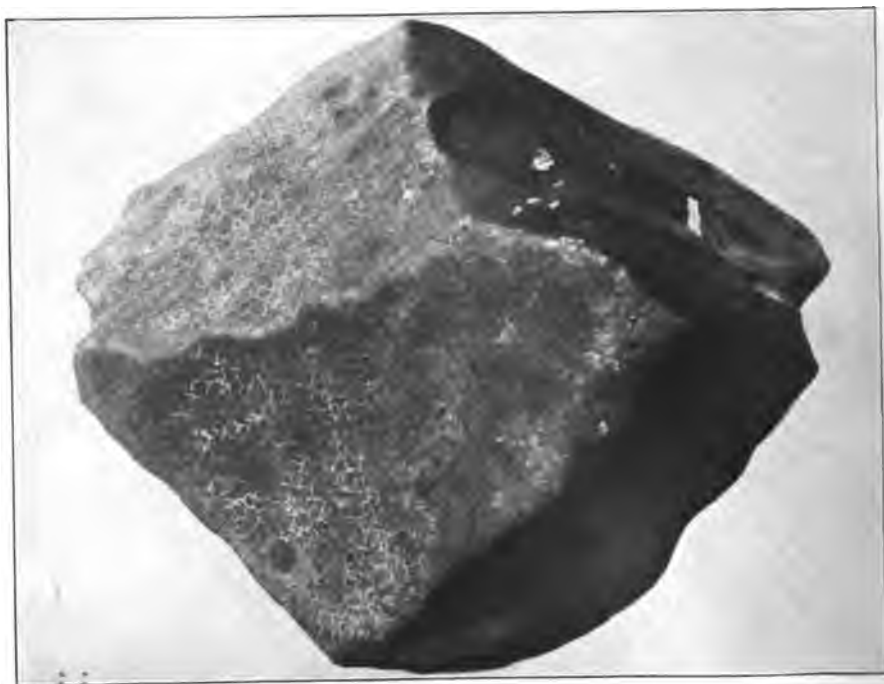
**COOSBY'S CREEK, COOKE COUNTY, TENNESSEE. No. 32.**

Iron, Og. One lot of fragments, weighing 69.16 grams, some of which show octahedral cleavage. Found in 1837.





1



2

(1) THE DALTON IRON AND (2) NEW CONCORD STONE.

FOR DESCRIPTIONS SEE PAGES 181 AND 190.



**CRANBERRY PLAINS, POPLAR HILL, VIRGINIA. No. 50.**

Iron, O. Fragment weighing 7.92 grams. Found in 1852.

**CRANBOURNE, VICTORIA, AUSTRALIA. (1) No. 59, (2) No. 59a.**

Iron, Og. (1) Fragment, weighing 10.6 grams, much oxidized and somewhat decomposed from occluded lawrencite; found in 1854. (2) Oxidized fragment, weighing 21 grams (Yarra Yarra River), found in 1858.

**CRONSTADT, ORANGE RIVER, ORANGE FREE STATE, SOUTH AFRICA. No. 225.**

Stone, Cga. Fragment with crust and polished surface, weighing 12.5 grams. Crust dull black, somewhat pitted and in swellings. Groundmass ash gray, with abundant metallic grains. Chondrules gray and white. Fell November 19, 1877.

**CROSS TIMBERS, RED RIVER, TEXAS. No. 18.**

Iron, Om. Two pieces, one weighing 62.85 grams, the other a cleavage crystal, weighing 0.85 gram. Known in 1808.

**CYNTHIANA, HARRISON COUNTY, KENTUCKY. No. 223.**

Stone, Cg. Fragment with crust, weighing 1.77 grams. Fell January 23, 1877.

**DALTON, WHITFIELD COUNTY, GEORGIA. (1) No. 90, (2) No. 245.**

Iron, Om. (1) Two pieces weighing 735.71 grams. Etched face shows broad Widmanstätten figures with scattering plates of taenite; surface more or less decomposed from presence of lawrencite. Found in 1879. (2) Nearly complete individual—weighing 50,340 grams, or 111 pounds. This is the mass described and figured by Shepard<sup>1</sup> but from which possibly 2 kilograms has been cut from the apex (pl. 39).

**DANIELS KULL, GRIQUALAND, SOUTH AFRICA. No. 204.**

Stone, Ck. Fragment from interior, weighing 4.6 grams. Ground mass ash gray flecked with rust. Fell March 20, 1868.

**DEAL, MONMOUTH COUNTY, NEW JERSEY. No. 157.**

Stone, Ci. Fragment with crust, weighing 4.19 grams. Groundmass ash gray, fine granular and compact with delicate veins ap-

<sup>1</sup>Amer. Journ. Sci., vol. 26, 1883, p. 336.

parently filled with nickel-iron somewhat oxidized. Structure chondritic with numerous metallic grains. Fell August 14, 1829.

DENTON COUNTY, TEXAS. No. 68.

Iron, Om. Etched fragment showing coarse Widmanstätten figures; weight, 7.97 grams. Found in 1856.

DESCUERIDORA, SAN LUIS POTOSI, MEXICO. No. 2.

Iron, Om. Oblong slabs, etched, weighing 24.8 grams. Known in 1780.

DHURMSALA, KANGRA, INDIA. No. 189.

Stone, Ci. Weight, 259.2 grams. Fell July 14, 1860, 2.30 p. m. (1) Fragment with faint, shining and much pitted crust. Ground-mass ash gray, compact, with finer grained bluish gray nodules and oxidized metallic grains distributed through it. (2) Fragment from interior, one surface polished. Two faces show fragmentary slickensides.

DONA INEZ, ATACAMA, CHILE. No. 117.

Stony-iron, Pallasite. Portion of mass, weighing 59.5 grams and showing original and polished surfaces. The metallic and stony parts are about equal in amount, the latter being distributed through the mass in reticulated shapes. The specimen exhibits in a slight degree the characteristic cracked surface. Found in 1888.

DRAKE CREEK, NEAR NASHVILLE, DAVIDSON COUNTY, TENNESSEE. No. 154.

Stone, Cwa. Fragment with crust, weighing 4.18 grams. Fell May 9, 1827.

DURANGO, MEXICO. No. 13.

Iron, Om. Etched fragment showing Widmanstätten figures; weight, 45.43 grams. One surface deeply pitted. Found in 1804.

EICHSTÄDT, BAVARIA, GERMANY. No. 127.

Stone, Cc. Fragment from interior, weighing 1 gram. Ground-mass coarse granular. Fell February 19, 1785.

EISENBERG, SAKE ALTENBERG, GERMANY. No. 85.

Iron, Pseudometeorite. Fragment weighing 9.7 grams. Found in 1873.

ELBOGEN, BOHEMIA, AUSTRIA. No. 1.

Iron, Om. Fragment weighing 4.45 grams. Found in 1400.





SPECIMENS OF THE ESTHERVILLE MESOSIDERITES.

FOR DESCRIPTION SEE PAGE 183.

U. S. NATIONAL MUSEUM  
BULLETIN 94  
PLATE 40

**EMMITSBURG, FREDERICK COUNTY, MARYLAND. No. 56.**

Iron, Om. Etched fragment weighing 5.5 grams; shows Widmanstätten figures. Found in 1854.

**ENSISHEIM, ALSACE, GERMANY. No. 122.**

Stone, Ckb. Two fragments from interior, weighing 4.3 grams; one vial of powder weighing 0.098 gram. Fell November 16, 1492, 11.30 p. m.

**ERKLEBEN, SAXONY, GERMANY. No. 140.**

Stone, Ck. Weight, 30.60 grams. Fragment with crust; also fragment from interior and vial of powder. Fell April 15, 1812, 4 p. m.

**ESTHERVILLE, EMMET COUNTY, IOWA. Nos. 121, 220, 221, 222.**

Stony-iron, Mesosiderite. Weight, 3,575 grams. Fell May 10, 1879, 5 p. m. One hundred and nine complete individuals varying in size from that of a pea to that of a hen's egg; their surfaces show rounded knobs and are partly steel white and partly steel blue to black in color (pl. 40). A section shows the iron in spongiform masses, nodules and irregular flakes distributed through the stony groundmass. The olivine nodules from above show a vitreous crust with marked lines of flow, again they are coated with nickel-iron. Five masses composed chiefly of stone show deeply pitted crust. Groundmass containing large nodules of olivine, nickel-iron, and troilite.

**FARMINGTON, WASHINGTON COUNTY, KANSAS. No. 242.**

Stone, Cs. Mass, weighing 489 grams, having the appearance of a dark gray dolerite. Crust smooth, showing scales or blisters in spots. Groundmass containing black chondrules; also white radiated chondrules and bronze yellow metallic grains. Fell June 25, 1890, 1 p. m.

**FORSYTH, MONROE COUNTY, GEORGIA. No. 156.**

Stone, Cwa. Two fragments, one with crust and one from interior, weighing 9.50 grams. Fell May 8, 1829, 3.30 p. m.

**FORT DUNCAN, MAVERICK COUNTY, TEXAS. No. 96.**

Iron, H. Slab weighing 116 grams, one surface etched. Etching develops Neumann lines as a network on a granular or stippled ground. Small grains of troilite are seen. Found in 1882.

**FRANKFORT, FRANKLIN COUNTY, ALABAMA. No. 205.**

Stone, Ho. Fragment weighing 47 grams, with shining, black, papillated crust having well-marked lines of flow. Fell December 5, 1868.

FUTTEEPUR, UNITED PROVINCES, INDIA. No. 148.

Stone, Cwa. Fragment with crust and polished surface, weighing 2.22 grams. Fell November 30, 1822.

GARGANTILLO (TOMATLAN), JALISCO, MEXICO. No. 229.

Stone, Cc. Weight, 511 grams. Mass with crust showing lines of flow and pittings; fragment from interior; one lot of fragments and powder. Fell August 17, 1879.

GIRGENTI, SICILY. No. 177.

Stone, Cwa. Fragment from interior, weighing 1.5 grams. Groundmass ash gray, fine granular. One surface shows a metallic slickenside. Fell February 10, 1853, 1 p. m.

GLORIETA, SANTA FE COUNTY, NEW MEXICO. No. 98.

Iron, Om. Section weighing 853.40 grams. Etched surface shows poor Widmanstätten figures, with one large nodule of troilite and several smaller ones. Found in 1884.

GRAND RAPIDS (WALKER TOWNSHIP), KENT COUNTY, MICHIGAN. No. 97.

Iron, Of. Weight, 34.5 grams. Found in 1883.

GROSSLIEBENTHAL, NEAR ODESSA, UKRAINE, RUSSIA. No. 232.

Stone, Cwa. Fragment from interior, weighing 8 grams. Groundmass ash gray, containing white chondrules and metallic grains. A thin vein composed apparently of nickel-iron, more or less oxidized, passes through the specimen. Fell November 19, 1881.

HAINHOLE, MINDEN, WESTPHALIA, GERMANY. No. 114.

Stony-iron, Mesosiderite. Fragment with polished surface, weighing 12.15 grams. Metallic grains small and scattered through a mass of bronzite in which are relatively large grains of olivine, with some asmanite and troilite. Found in 1856.

HARRISON COUNTY, INDIANA. No. 187.

Stone, Cho. Fragment with crust and polished surface, weighing 36.4 grams. Fell March 28, 1859.

HARTFORD (MARION), LINN COUNTY, IOWA. No. 170.

Stone, Cwa. Weight, 1,602.35 grams. Mass with thick, dull black crust, pitted and marked with swells and furrows as a result of flow. Interior ash gray, one surface marked with a metallic slickenside,

much oxidized. The mass is traversed by metallic veins or lines of fracture which mark slipping zones with slickensided surfaces. Fell February 25, 1847, 2.45 p. m.

**HESSLE, LAKE MALAR, SWEDEN. No. 206.**

Stone, Cc. Four fragments with thin, dull black, papillated crust, weighing 259.8 grams. Fell January 1, 1869, 12.30 p. m.

**HEX RIVER, CAPE COLONY, SOUTH AFRICA. No. 95.**

Iron, H. Section weighing 14.3 grams. Etched surface shows Neumann lines. Found in 1882.

**HOMESTEAD (WEST LIBERTY), IOWA. No. 219.**

Stone, Cgb. Weight, 3,185 grams. Four complete individuals covered with crust and indented with broad shallow pits. Crust dull black, thin, and somewhat blebby. Three fragments showing interior having an abundance of metallic grains and chondritic structure. Fell February 12, 1875, 10.15 p. m.

**HONOLULU, MAWAIHAN ISLANDS. No. 152.**

Stone, Cwa. Fragment with crust, weighing 1.35 grams. Fell September 27, 1825.

**HRASCHINA, AGRAM, CROATIA, HUNGARY. No. 2.**

Iron, Om. Etched fragment showing Widmanstätten figures. Weight, 0.737 gram. Fell May 26, 1751.

**IMILAC, ATACAMA, CHILE. No. 111.**

Stony-iron, Pallasite. Fragment, the metallic matrix as well as the olivine of which have undergone decomposition; vial of fragments of matrix with little or no olivine; vial of fragments of iron and olivine but little altered. Total weight, 25.75 grams. Found in 1827.

**IVAN, ODENBURG, HUNGARY. No. 163.**

Pseudometeorite. Weight, 0.94 gram.

**IVANPAH, SAN BERNARDINO COUNTY, CALIFORNIA. No. 92.**

Iron, Om. Etched section showing Widmanstätten figures. Weight, 11.75 grams. Found in 1880.

**JAMESTOWN, STUTSMAN COUNTY, NORTH DAKOTA. No. 101.**

Iron, Of. Cross section of mass with polished surface, weighing 74.15 grams. Found in 1885.

JEFFERSON (30 MILES FROM DENVER), COLORADO. No. 81.

Iron. Fragment weighing 41 grams, containing troilite nodule; somewhat decomposed from occluded chlorides. Fell in June, 1867.

JEWELL HILL, MADISON COUNTY, NORTH CAROLINA. No. 84.

Iron, Of. Rectangular section showing portion of surface. Weight, 31.85 grams. Etched face showing Widmanstätten figures; taenite plates well developed. Found in 1854.

JOE WRIGHT MOUNTAIN, INDEPENDENCE COUNTY, ARKANSAS. No. 100.

Iron, Om. Weight, 20 grams. Section showing typical Widmanstätten figures. The markings are broad and regular with large plates of troilite. Found in 1884.

JONZAC, CHARENTE-INFERIEURE, FRANCE. No. 143.

Stone, Eu. Fragment weighing 0.17 gram. Fell June 13, 1819.

JUVINAS, ARDECHE, LANGUEDOC, FRANCE. No. 146.

Stone, Eu. Fragment from interior, weighing 39.5 grams. Fell June 15, 1821, 3.30 p. m.

KABA, NEAR DEBRECZIN, HUNGARY. No. 183.

Stone, K. Fine powder; weight, 6.20 grams. Fell April 15, 1857.

KERILIS, CÔTES-DU-NORD, FRANCE. No. 111.

Stone, Cga. Fragment with crust, weighing 2.70 grams. Fell November 26, 1874.

KERNOUVÉ, MORBIHAN, BRITTANY, FRANCE. No. 207.

Stone, Ck. Fragment from interior, weighing 52.65 grams. Fell May 22, 1869, 10 p. m.

KHAIRPUR, BHAWALPUR, INDIA. No. 217.

Stone, Ck. Fragment with polished surface and crust, weighing 26.75 grams. Crust dull black, blebby, and showing lines of flow. Groundmass dark gray, compact. Fell September 23, 1873.

KNYAHINYA, NEAR NAGY-BEREZNA, HUNGARY. No. 200.

Stone, Cg. Weight, 32.83 grams. Complete individual covered with thin black crust and having a pitted surface; fragment with crust and polished surface. Fell June 9, 1866, 5 p. m.

**KRASNOJARSK, JENISEISK, SIBERIA. No. 119.**

Stony-iron, Pallasite. Section weighing 327 grams. The spongi-form metallic matrix incloses nodules of olivine of varying diameters, more or less transparent and vitreous and varying in color from honey-yellow to nearly black. Also fragments of matrix from which the olivine has disappeared. Found in 1749.

**KULESCHOWKA, POLTAWA, RUSSIA. No. 139.**

Stone, Cwa. Fragment with crust, weighing 5.95 grams. Fell March 12, 1811 (midnight).

**LA BECASSE, INDRE, FRANCE. No. 228.**

Stone, Cw. Fragment with crust, weighing 5 grams. Fell January 31, 1879.

**LA CAILLE, NEAR GRASSE, VAR, FRANCE. No. 4.**

Iron, Om. Fragment weighing 1.48 grams. Found in 1600.

**LA GRANGE, OLDHAM COUNTY, KENTUCKY. No. 69.**

Iron, Of. (1) Section marked "Oldham," weighing 1,019 grams; Widmanstätten figures slightly indicated. (2) Section weighing 983 grams, with well-marked Widmanstätten figures. Found in 1860.

**L'AIGLE, ORNE, FRANCE. No. 132.**

Stone, Cib. Fragment with crust, weighing 11.35 grams. Fell April 26, 1803, 1 p. m.

**LANCÉ, LOIR-ET-CHER, FRANCE. No. 215.**

Stone, Cc. Fragment with dull black blebby crust, weighing 7 grams. Groundmass dark gray, fine grained, compact. Fell July 23, 1872.

**LEWARTO, GALICIA, AUSTRIA. No. 17.**

Iron, Om. Two fragments, one polished, weighing 1 gram, the other weighing 16.52 grams, etched on both sides and showing Widmanstätten figures. Found in 1814.

**LES ORMES, YONNE, FRANCE. No. 183.**

Stone, Cw. Fragments from interior, weighing 0.70 gram. Fell October 1, 1857.

**LEXINGTON COUNTY, SOUTH CAROLINA. No. 93.**

Iron, Og. Weight, 2,820 grams. Part of mass containing large troilite nodule. Found in 1880.

LICK CREEK, DAVIDSON COUNTY, NORTH CAROLINA. No. 91.

Iron, H. Fragment weighing 9.72 grams. Found in 1879.

LION RIVER, GREAT NAMAQUALAND, SOUTH AFRICA. No. 51.

Iron, Of. Section weighing 20.85 grams, showing original surface. Etched portion shows fine Widmanstätten figures, the plates narrow and distinct. First described in 1853.

LITTLE PINEX, FULASKI COUNTY, MISSOURI. No. 161.

Stone, Cc. Fragment from interior, weighing 75.44 grams. Fell February 13, 1839.

LIXNA, DÜNABURG, VITEBSK, RUSSIA. No. 145.

Stone, Cga. Fragment with crust, weighing 1.19 grams. Fell July 12, 1820.

LOSTTOWN, CHEROKEE COUNTY, GEORGIA. No. 77.

Iron, Om. Weight 75.4 grams. Section, one surface etched showing Widmanstätten figures; three vials of powder. Found in 1864.

LUCIGNANO D'ASSO (SIENA), TUSCANY, ITALY. No. 243.

Stone, Cho. Fragments weighing 3.7 grams. Fell June 16, 1794.

LUMPKIN, STEWART COUNTY, GEORGIA. No. 209.

Stone, Cc. Fragment with crust and polished surfaces, weighing 1.62 grams. Fell October 6, 1869, 11.45 a. m.

MADOC, HASTINGS COUNTY, ONTARIO, CANADA. No. 57.

Iron, Of. Section weighing 12 grams, showing coarse Widmanstätten figures. Found in 1854.

MAGURA (ARVA), SZLÁNICA, HUNGARY. No. 35.

Iron, Og. Fragment weighing 123.50 grams. Found in 1840.

MARSHALL COUNTY, KENTUCKY. No. 62.

Iron, Om. Two fragments weighing 68.23 grams. First described in 1860.

MARYLAND. No. 15.

A shaving, weighing 2.735 grams, from burned museum in Baltimore, Maryland.

**MAUERKIRCHEN, AUSTRIA. No. 125.**

Stone, Cw. Fragment from interior, weighing 0.5 gram. Fell November 20, 1768, 4 p. m.

**MENOW, MECKLENBURG, GERMANY. No. 191.**

Stone, Cck. Fragment from interior, weighing 2.1 grams. Fell October 7, 1862, 1.30 p. m.

**MEZŐ-MADARAS, TRANSYLVANIA, HUNGARY. No. 175.**

Stone, Cgb. Nearly complete individual with crust, weighing 86.8 grams. Fell September 4, 1852, 4.30 p. m.

**MIGHÉL, TRANSCAUCASIA, RUSSIA. No. 341.**

Stone, K. Fragment weighing 10 grams, dull black and soft friable, soiling the fingers. Carbonaceous meteorite. Fell June 18, 1889.

**MILENA (PUSINSKO SELO), WARASDIN, CROATIA, HUNGARY. No. 164.**

Stone, Cw. Fragment from interior, weighing 46.25 grams; one surface appreciably slickensided. Fell April 26, 1842, 3 p. m.

**MISTECA, OAXACA, MEXICO. No. 12.**

Iron, Om. Two fragments, one polished, weighing 2.5 grams; the other etched, developing Widmanstätten figures, and weighing 16 grams. Found in 1804.

**MOCS, TRANSYLVANIA, HUNGARY. No. 234.**

Stone, Cwa. Fragment with crust, one surface polished, weighing 17.85 grams. Fell February 3, 1882, 4 p. m.

**MOLINA, MURCIA, SPAIN. No. 166.**

Stone, Cgb. Fragment with crust, weighing 3.67 grams. One surface apparently slickensided. Fell December 24, 1858.

**MONROE (CABARRUS COUNTY), NORTH CAROLINA. No. 173.**

Stone, Cga. Two fragments, one with crust and another with two surfaces polished, weighing 343.6 grams. Fell October 31, 1849, 3 p. m.

**MONTEMILONE (MACERATA), ITALY. No. 169.**

Stone, Cwb. Fragment with crust, weighing 0.73 gram. Fell May 8, 1846.

**MOORESFOOT (TIPPERARY), IRELAND. No. 137.**

Stone, Cga. Fragment with dull black crust, weighing 1 gram. Fell in August, 1810.

**MORDVINOVKA, PAVLOGRAD, EKATERINOSLAV, RUSSIA. No. 152.**

Stone, Cw. Three fragments; one with crust. Weight, 3.11 grams. Fell May 19, 1826.

**MOTTA DE CONTI, PIEDMONT, ITALY. No. 202.**

Stone, Cc. Fragment with papillated shiny black crust, weighing 1.53 grams. Fell February 29, 1868.

**MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE. No. 41.**

Iron, Om. Fragment weighing 5.88 grams. First described in 1848.

**MANJEMOY, CHARLES COUNTY, MARYLAND. No. 181.**

Stone, Cc. Fragment with crust, weighing 31.22 grams. Fell February 10, 1825, 12 m.

**MEJED (WADEE BANEE KHALED), CENTRAL ARABIA. No. 72.**

Iron, Om. Sawn section weighing 37 grams. Fell in spring of 1863.

**NELSON COUNTY, KENTUCKY. No. 68.**

Iron, Ogg. Section of mass, weighing 58.3 grams. Found in 1860.

**NENNTMANNSDORF, NEAR PIRNA, SAXONY, GERMANY. No. 82.**

Iron, H. Two fragments, one weighing 2.45 grams; the other, a fragment of crust, weighing 12.70 grams and showing a green efflorescence of nickel compounds. Found in 1872.

**NETSCHAEVO, TULA, RUSSIA. No. 28.**

Iron, Om. Fragment weighing 61.95 grams. The iron is rich in silicates. Found in 1846.

**NEW CONCORD, MUSKINGUM COUNTY, AND GUERNSEY COUNTY, OHIO. No. 134.**

Stone, Cia. Nearly complete individual covered with a somewhat pitted black crust, and weighing 3,311.87 grams (pl. 39). Fell May 1, 1860, 12.45 p. m.

**NEWSTEAD, ROXBURGHSHIRE, SCOTLAND. No. 22.**

Iron, Dn. Triangularly shaped fragments; weight, 51 grams. Found in 1827.

## NIAKORNAK, GREENLAND.

Telluric iron. Weight, 5.7 grams. Found in 1848 or 1850.

NOWO-UREI, KRASNOSLOBODSK, PENZA, RUSSIA. No. 240.

Stone, Cu. Fragment from interior, weighing 4 grams. Ground-mass black (ureilite); coarse granular. Fell September 22, 1886.

OBERNKIRCHEN, SCHAUMBURG-LIPPE, GERMANY. No. 71.

Iron, Of. Two sections, one showing troilite nodule and weighing 30.3 grams; the other weighing 23.1 grams. Found in 1863.

OKTIBBEHA, MISSISSIPPI. No. 55.

Iron, Db. Weight, 1.89 grams. Found in 1854. Doubtfully meteoric.

ORANGE RIVER, SOUTH AFRICA. No. 64.

Iron, Om. Etched section with original surfaces. Widmanstätten figures coarse, taenite plates narrow. Weight, 21.41 grams. First described in 1856.

ORGUEIL, MONTAUBAN, TARN-ET-GARONNE, FRANCE. No. 196.

Stone, K. Coarse, black, friable powder, weighing 9.62 grams. Fell May 14, 1914, 8 p. m.

ORNANS, DOUBS, FRANCE. No. 203.

Stone, Cco. Fragment from interior, weighing 6 grams. Ground-mass dark ash gray. Chondrules made up of ornansite and ngawite. Fell July 11, 1868.

ORVINIO, UMBRIA, ITALY. No. 216.

Stone, Co. Fragment with crust, weighing 0.12 gram. Fell August 31, 1872.

ÖSEL (KAANDE), LIVONIA, RUSSIA. No. 178.

Stone, Cw. Fragment from interior, weighing 4 grams. Fell May 11, 1855, 3.30 p. m.

OVIFAK (DISCO), GREENLAND.

Telluric iron. Weight, 18.97 grams. Found in 1870.

PACULA, JACALA, HIDALGO, MEXICO. No. 236.

Stone, Cwb. Two fragments from interior, weighing 13 grams. Groundmass traversed by several delicate veins. Fell June 18, 1881.

PARNALLEE, NEAR MADURA, MADRAS, INDIA. No. 181.

Stone, Cga. Two fragments with crust, weighing 331.48 grams. Crust black, pitted, and in swellings. Fell February 28, 1857, 12 m.

**PAVLOVKA, SARATOV, RUSSIA. No. 235.**

Stone, Ho. Fragment with crust, also a vial of fragments; weight, 5.61 grams. Fell August 2, 1882.

**PETERSBURG, LINCOLN COUNTY, TENNESSEE. No. 179.**

Stone, Ho. Two fragments with crust, weighing 30.7 grams. Crust shiny black, pitted, and in swellings. Fell August 5, 1855.

**PILLISTFER (AUKOMA), POLAND, RUSSIA. No. 192.**

Stone, Ck. Fragment from interior, weighing 2.6 grams. Fell August 8, 1863, 12.30 p. m.

**POLITZ, NEAR GERA, REUSS, GERMANY. No. 144.**

Stone, Cwa. Fragment with crust, weighing 0.163 gram. Fell October 13, 1819, 8 a. m.

**PRAIRIE DOG CREEK, DECATUR COUNTY, KANSAS. No. 244.**

Stone, Cck. Mass with crust, weighing 220 grams. Crust scorified on one surface, papillated on another. Known in 1893.

**PRAMBANAN, JAVA. No. 11.**

Iron, Of. Fragment weighing 2.3 grams. Found in 1797.

**PULTUSK, POLAND, RUSSIA. No. 201.**

Stone, Cga. Weight, 304.76 grams. Seven complete individuals. Crust dull black, more or less papillated and pitted. Also a cross section of an individual with crust and polished surface. Fell January 30, 1868, 7 p. m.

**PUTNAM COUNTY, GEORGIA. No. 28.**

Iron, Of. Four fragments weighing 68.55 grams. Found in 1839.

**QUENGGOUK, PEGU, BURMA. No. 164.**

Stone, Cc. Fragment with crust and one vial of powder weighing 19.65 grams. Fell December 27, 1857.

**RAKOWKA, TULA, RUSSIA. No. 237.**

Stone, Ci. Fragment with crust indented with broad shallow pits, weighing 23.5 grams. Fell November 20, 1878.

**RANCHITO, NEAR BACUBIRITO, SINALOA, MEXICO. No. 102.**

Iron, Off. Weight, 171.4 grams. Part of mass with original and etched surfaces; delicate Widmanstätten figures. Found in 1871.

**RASGATA (TOCAVITA), COLOMBIA. No. 18.**

Iron, Ds. Small polished section weighing 15 grams. Found in 1810.

**RENAZZO, NEAR CENTO, FERRARA, ITALY. No. 149.**

Stone, Cs. Fragment with crust weighing 7.20 grams. Fell January 15, 1824.

**RICHMOND, VIRGINIA. No. 155.**

Stone, Cck. Fragment from interior weighing 3.69 grams. Fell June 4, 1828, 8.30 a. m.

**ROCHESTER, FULTON COUNTY, INDIANA. No. 221.**

Stone, Cc. Two fragments with dull black, blebby crust, weighing 48.27 grams. Fell December 21, 1876.

**ROEBOURNE (200 MILES SOUTHEAST OF), WEST AUSTRALIA. No. 109.**

Iron, Om. Weight, 157 grams. Etched section showing typical Widmanstätten figures with scattering grains of troilite. Found in 1892.

**RUFF'S MOUNTAIN, LEXINGTON COUNTY, SOUTH CAROLINA. No. 46.**

Iron, Om. Weight, 5461 grams. Large block, etched on one face and showing Widmanstätten figures, and two small fragments. Found in 1844.

**SAINT FRANCOIS COUNTY, SOUTHEASTERN MISSOURI. No. 72.**

Iron, Og. Fragment weighing 5.6 grams. Found in 1863.

**SAINT-MESMIN, NEAR TROYES, AUBE, FRANCE. No. 199.**

Stone, Cib. Fragment with crust weighing 1.59 grams. Fell May 30, 1866.

**SALLES, NEAR VILLEFRANCHE, RHONE, FRANCE. No. 130.**

Stone, Cia. Gray powder, weighing 2 grams. Fell March 12, 1798.

**SALT RIVER, KENTUCKY. No. 47.**

Iron, Hch(?). Two sections weighing 26.2 and 25.36 grams, respectively. Found in 1850.

**SANCHEZ ESTATE, COAHUILA, MEXICO. No. 61.**

Iron, H. Two fragments weighing 183.7 grams, one showing fracture. Known prior to 1837.

5692°—Bull. 94—16—13

SANTA CATHERINA, RIO SAN FRANCISCO DO SUL, BRAZIL. (1) No. 87, (2) No. 88, (3) No. 106.

Iron, Og. (1) Section weighing 234 grams, and showing no evidence of alteration; one surface etched, Widmanstätten figures broad with scattering plates of taenite and some troilite. Analysis shows 36 per cent of nickel. (2) Two fragments weighing 15 grams, somewhat oxidized on surface, but with a compact metallic interior. (3) Complete mass apparently altered to limonite; surface somewhat pitted by decay. Known in 1873.

SAREPTA, SARATOV, RUSSIA. No. 60.

Iron, Og. One lot of turnings weighing 3.3 grams. Found in 1854.

SCHWETZ, PRUSSIA, GERMANY. No. 48.

Iron, Om. Fragment weighing 10.55 grams. Found in 1850.

SCOTTSDALE, ALLEN COUNTY, KENTUCKY. No. 80.

Iron, H. Cross section etched showing Neumann lines, and weighing 713 grams. Found in 1867.

SCRIBA, OSWEGO COUNTY, NEW YORK. No. 23.

Iron, Dn. Polished section weighing 61.33 grams. Found about 1835.

SEARSMONT, WALDO COUNTY, MAINE. No. 211.

Stone, Cc. Fragment with dull black papillated crust, weighing 62.5 grams. Fell May 21, 1871, 8.15 a. m.

SEELÄSGEN, BRANDENBURG, PRUSSIA, GERMANY. No. 44.

Iron, Ogg. Etched slab weighing 111.6 grams; shows irregular lines of troilite and plates of nickel-iron alloy. Found in 1847.

SENECA FALLS, SENECA COUNTY, NEW YORK. No. 49.

Iron, Om. Section of mass, weighing 80.2 grams. Found in 1851.

SHYTAL, NEAR DACCA, BENGAL, INDIA. No. 193.

Stone, Cib. Fragment from interior weighing 1.32 grams. Fell August 11, 1863.

SIENA, TUSCANY, ITALY. No. 128.

Stone, Cho. Complete individual showing crust and interior, weighing 6.75 grams. Fell June 16, 1794.

SKI, AMT AKERSHUS, NORWAY. No. 172.

Stone, Cwa. Fragment with crust, weighing 1 gram. Fell December, 27, 1848.

SMITHLAND, LIVINGSTON COUNTY, KENTUCKY. No. 30.

Iron, Db. Section weighing 12.935 grams. Found 1839-40.

SMITHVILLE, DEKALB COUNTY, TENNESSEE. No. 106.

Iron, Og. A portion of mass, weighing 1,937 grams; natural surface in part altered from occluded chlorides; one surface showing nodules of troilite. Found in 1893.

SOKO-BANJA (SARBANOVAC), SERBIA. No. 224.

Stone, Cc. Fragment with crust, weighing 15.98 grams. Fell October 13, 1877, 2 p. m.

STÄLLDALEN, NEAR KOPPARBERG, SWEDEN, No. 230.

Stone, Cgb. Two fragments with crust, weighing 151.7 grams. Crust surface indented with broad, shallow pits. Groundmass shows fragmentary slickensides. Fell June 28, 1876, 11.30 a. m.

STANNERN, NEAR IGLAU, MORAVIA, AUSTRIA. No. 136.

Stone, Eu. Fragment with glossy black to shiny crust, weighing 25.70 grams. Fell May 22, 1808, 6 a. m.

STAUNTON, AUGUSTA COUNTY, VIRGINIA. No. 73.

Iron, Om. Cross section of mass containing large troilite nodules, weighing 1,662 grams. Etched surface shows typical Widmanstätten figures. Found in 1869.

STEINBACH (RITTERSGRÜN), SAXONY, GERMANY. (1) No. 112, (2) No. 114.

Stony-iron, Pallasite. Found 1847. (1) Section with crust, weighing 65.45 grams. The stony portion exceeds the metallic, which consists chiefly of nickel-iron with some small masses of troilite. On one surface the metallic portion has been etched showing Widmanstätten figures. (2) Fragment weighing 16.8 grams.

SUPURHEE, GORUCKPUR, INDIA. No. 197.

Stone, Cgb. Fragment with crust, weighing 4.3 grams. Crust contains small globules of nickel-iron. Fell January 19, 1865.

TABOR, BOHEMIA, AUSTRIA. No. 122.

Stone, Ccb. Section from interior, weighing 2.45 grams. Fell June 3, 1753, 8 p. m.

TAJGHA, KRASNOJARSK, SIBERIA. No. 246.

Iron, Om. Fragment with original surface, weighing 64 grams. Etch figures coarse and poor. Found in 1891.

TARAPACA, CHILE. No. 31.

Iron, Db. Fragment, weighing 84 grams. Found in 1840.

TAZEWELL, CLAIBORNE COUNTY, TENNESSEE. No. 52.

Iron, Off. Cross section showing crust, one side polished, weighing 1,593.5 grams; sawed section, weighing 350 grams, shows crust. One surface etched showing fine Widmanstätten figures, the plates narrow and distinct. One vial of turnings. Found in 1853.

TENNASILM (SIKKENSAARE), ESTHLAND, RUSSIA. No. 214.

Stone, Cca. Two fragments with a small portion of crust, weighing 1.76 grams. Fell June 25, 1872.

TIESCHITZ, PRERAU, MORAVIA, AUSTRIA. No. 226.

Stone, Cc. Fragment with dull black crust, weighing 27 grams. Fell July 15, 1878.

TIMOSCHIN, JUCHNOW, SMOLENSK, RUSSIA. No. 194.

Stone, Cc. Fragment from interior, weighing 15 grams. Fell March 25, 1807.

TJABE, REMBANG, JAVA. No. 202.

Stone, Ck. Fragment with crust, weighing 29.1 grams. Fell September 19, 1869.

TOLUCA (XIQUIPILCO), MEXICO. (1) No. 5, (2) No. 6.

Iron, Om. Total weight, 18,573 grams. Complete individual, weighing 17,800 grams, having a pitted surface, and two polished and etched slices, weighing 85 and 688 grams, showing Widmanstätten figures. Found in 1784.

TOMHANNOCK CREEK, RENSSELAER COUNTY, NEW YORK. No. 196.

Stone, Cgb. Two slices, polished and showing crust, weighing 8.74 grams. Found in 1863.

TOURINNES-LA-GROSSE, NEAR TIRLEMONT, BELGIUM. No. 194.

Stone, Cw. Fragment with crust, weighing 9.04 grams. Fell December 7, 1863.

## TRENTON, WASHINGTON COUNTY, WISCONSIN. No. 66.

Iron, Om. Two fragments, weighing 91.46 grams. Found in 1858.

## TRENZANO, NEAR BRESCIA, LOMBARDY, ITALY. No. 180.

Stone, Cca. Fragment weighing 3.8 grams. Fell November 12, 1856, 4 p. m.

## TRINITY COUNTY (CANYON CITY), CALIFORNIA. No. 103.

Iron, Og. Fragments weighing 22.55 grams. Found in 1870.

## TUCSON (CARLETON), ARIZONA. No. 39.

Iron, Dt. Weight, 36.84 grams. Found in 1846.

## TUCSON (RING), ARIZONA. No. 40.

Iron, Dt. Fragment from inner circle of ring meteorite, weighing 84.5 grams. 1846?

## TUCUMAN (CAMPO DEL CIELO), ARGENTINA. No. 7.

Iron, Ds. Fragment having one surface polished and weighing 23.8 grams. Found in 1788.

## TYNES, NORWAY. No. 338.

Stone, Cgb. Fragment from interior, weighing 29.3 grams. Fell May 20, 1884.

## UNION COUNTY, GEORGIA. No. 53.

Iron, Ogg. Section having a much oxidized surface and showing cleavage lines, weighing 87 grams; section weighing 36.5 grams and a vial of oxidized crust. Found in 1853.

## UTRECHT (BLAAUW KAPEL), HOLLAND. No. 167.

Stone, Cca. Two fragments, one weighing 3.1 grams, with crust; another from interior, weighing 5.79 grams. Fell June 2, 1843.

## VACA MUERTA, ATACAMA, CHILE. (1) No. 119, (2) No. 116.

Stony-iron, Mesosiderite. (1) Three fragments, two of which are thin sections; the third shows original and polished surfaces. Structure somewhat granular, with the metallic and nonmetallic portions about equally distributed. Weight, 27.63 grams. Found in 1862. (2) Mejillones. Thin section in which the metallic portion is dis-

tributed in occasional nodules and filiform shapes throughout the stony groundmass. Weight, 29.8 grams. Found in 1867-68.

**VICTORIA (SASKATCHEWAN RIVER), BRITISH COLUMBIA. No. 79.**

Iron, Om. Weight, 125 grams. Found in 1871.

**VICTORIA WEST, CAPE COLONY, SOUTH AFRICA. No. 70.**

Iron, Ofv. Fragments of crust almost completely altered to limonite, weighing 2.15 grams. Found in 1862. Fell? 1862.

**VOUILLE, NEAR POITIERS, VIENNE, FRANCE. No. 158.**

Stone, Cia. Fragment from interior, weighing 14.57 grams. Fell May 13, 1831.

**WACONDA, MITCHELL COUNTY, KANSAS. No. 213.**

Stone, Ccb. Weight, 884 grams. Mass with pitted and blebby crust showing lines of flow; also a fragment from the interior. Found in 1874.

**WARRENTON, WARREN COUNTY, MISSOURI. No. 232.**

Stone, Cc. Fragment with crust, weighing 27.25 grams. Groundmass friable, bluish gray, and resembling indurated arenaceous blue clay. Fell January 3, 1877, 7 a. m.

**WELLAND, ONTARIO, CANADA. No. 108.**

Iron, Om. Section having original and etched surface, weighing 36.5 grams. Widmanstätten figures coarse and regular with scattering grains of troilite. Lines of octahedral cleavage well marked. Found in 1888.

**WERCHNE-UDINSK, TRANSBAIKALIA, EAST SIBERIA. No. 58.**

Iron, Om. Etched section, weighing 36.30 grams. Widmanstätten figures coarse. Found in 1854.

**WESTON, FAIRFIELD COUNTY, CONNECTICUT. No. 135.**

Stone, Ccb. Three fragments, one without crust, weighing 74.87 grams. Fell December 14, 1807, 6.30 a. m.

**WICHITA COUNTY (BRAZOS RIVER), TEXAS. No. 26.**

Iron, Og. Two sections, one with original and etched surface, weighing 143 grams, and another weighing 69.40 grams. Both show coarse Widmanstätten figures with nodules of troilite and flakes of schreibersite. Found in 1836.

**WOLD COTTAGE, YORKSHIRE, ENGLAND. No. 120.**

Stone, Cwa. Fragment with crust and polished surface, weighing 13.02 grams. Fell December 13, 1795, 3.30 p. m.

**WOOSTER, WAYNE COUNTY, OHIO. No. 65.**

Iron, Om. Rectangular fragment weighing 2.86 grams. Found in 1858.

**YATOOR, NEAR NELLORE, MADRAS, INDIA. No. 174.**

Stone, Cc. Fragment from interior, weighing 2.81 grams. Fell January 23, 1852, 4.30 p. m.

**ZACATECAS, MEXICO. No. 9.**

Iron, Obs. Fragments with original and etched surfaces, weighing 175.3 grams. Widmanstätten figures good. Found in 1792.







1



2



3



4



5



6



7



8



9

MOLDAVITES AND SIMILAR SPORADIC GLASSES.

FOR DESCRIPTION SEE PAGE 201.

100

## APPENDIX A.

### MOLDAVITES, BILLITONITES, AND OTHER GLASSES OF SUPPOSED METEORIC ORIGIN.<sup>1</sup>

Peculiar pebbles of a greenish, chrysolite-like glass found in the gravels in regions remote from volcanoes or manufactories attracted the attention of observers in Bohemia and Moravia as long ago as 1787. The literature since that date contains numerous references to these and somewhat similar occurrences in India, Australia, and other widely separated localities, the descriptive matter as a rule being accompanied by speculations regarding the ultimate source of the materials.

In Moravia and Bohemia the objects are found with quartz pebbles in the late Diluvian and Tertiary conglomerates, but are never referable directly to the same. In Java they are found in Quaternary tuffs, and in the platinum mines southeast of Borneo. On the island of Billiton they are found in the Quaternary and perhaps Pliocene tin-bearing gravels. In Australia they have been found mainly on the surface of the ground, and no positive proof of their existence in Tertiary beds has as yet appeared. According to information received from George W. Card, of the Mining and Geological Museum, Sydney, the examples from Bimbowrie in southern Australia were found on a plain thickly covered with weathered quartz which resulted from the denudation of the adjacent quartz reefs. Most of them were broken and shattered as though by a fall; all lay loosely on the surface.

In appearance and general physical properties these various bodies from widely separated sources possess certain points in common, but are yet so different in appearance that examples from any one locality are readily distinguished from those of another. The Moravian and Bohemian forms, as will be noted by reference to Nos. 54093-98, 77525, and 77872, pl. 41, figs. 4-6, are more or less rounded pebbles or flattened slag-like masses, the surfaces of which are pitted in a way which has been compared by some writers to the thumb-like

---

<sup>1</sup> For a full bibliography of this subject up to and including 1898, see Franz E. Suess, *Die Herkunft der Moldavite und verwandter Gläser*, Jahrb. d. k. k. geol. Reichsanstalt, Heft 2, vol. 50, 1900, pp. 193-381. This includes 55 titles referring to the occurrences in Europe, the Sunda Archipelago, and Australia. A bibliography of the Australian and Tasmanian occurrences is given by R. H. Walcott in his paper on *The Occurrence of So-called Obsidian Bombs*, in the *Proc. Roy. Soc. Victoria*, 1898, pp. 28-52.

pittings on meteorites. In addition to this, they are dulled and rendered opaque through abrasion from other stony particles, very much like ordinary pebbles from the bed of a stream. In some instances they are deeply cut or notched as in fig. 5. The colors are chrysolite green, and the refractive index so high that they have in some instances been cut and utilized as gems.

The examples from Billiton (No. 77761), shown in pl. 41, figs. 1-3, are much more remarkable both on account of their shape and the extraordinary groovings which traverse the surface in all directions. They are of a deep, lustrous black color and translucent only on the thinnest edges.

The Australian and Tasmanian occurrences have more the appearance of water-worn pebbles which have been abraded by wind-blown sand (Nos. 77611-12, 77525, and 88454, pl. 41, figs. 7-9). These are also black and opaque excepting on the thinnest edges. In all, the glass is wholly amorphous without trace of the trichites so characteristic of obsidian and other volcanic glasses. A few characteristic forms only are shown.

Chemically, as will be noted in the selected analyses referred to later, these forms are all acid glasses approximating in composition the glassy forms of terrestrial rhyolites but unusually rich in lime and magnesia. They are also remarkable for their small water content as indicated by loss on ignition, and their high fusing point.

In none of the occurrences are the objects found in regions of volcanic rocks or under conditions which seem to render it at all likely that they are of local derivation. It is seemingly impossible to conceive of their having been ejected as volcanic bombs and drifted by winds, and equally impossible, apparently, that they should belong to either stream or glacial drift. An artificial origin is likewise considered impossible by the majority of those who have given the subject consideration, and of late those who should be best qualified to judge have been disposed to consider them as of a meteoric nature.

In recognition of a possible doubt on this point, however, the exhibit is accompanied by a small series of undoubted obsidian fragments and pebbles which bear somewhat similar markings, in some cases natural, in others produced artificially by means of fluorhydric acid. These are described below:

(1) *Obsidian pebbles from near Cali, Department of Cauca, Colombia, South America* (Cat. No. 63471).—These were received at the Museum from B. S. Hobbs through Dr. George F. Kunz, with the simple labeling "Obsidian" from the locality above given.

Two of the larger forms, it will be noted, are roughly spherical, each showing on one side a flattened area as though it had at some time been attached to a larger mass or had remained in one position during the etching process, since the larger grooves are

entirely absent from these portions. The surface markings are of three kinds: First, those which appear like original conchoidal fractures, the sharp angles of which have been reduced by corrosion; second, a series of shallow pits and grooves which are distributed fairly uniformly over the entire surface except the flattened portion mentioned; and, third, a very fine stipple-like pitting which gives the surface a shagreen-like appearance. This shagreen effect with numerous small, nearly circular, shallow pits occurs also on the flat areas where the larger groovings are lacking as already stated. Thin sections under the microscope show a faint smoky glass almost completely isotropic, but with an occasional minute, colorless, doubly refracting point too small for satisfactory determination. A peculiar series of anastomizing cracks much resembling the crackle structure on certain porcelain glazes, traverses the section in all directions.

The composition of this glass, as shown by an analysis of a portion cut from the larger of the specimens, is given in column I below. In columns II to IV are given analyses of tektites, as they have been comprehensively called, from Tasmania, Australia, and Bohemia.

*Analyses of Tektites.*

Constituent.	I.	II.	III.	IV.
$\text{SiO}_2$ .....	75.87	69.80	76.25	77.96
$\text{Al}_2\text{O}_3$ .....	14.35	15.02	11.30	12.20
$\text{Fe}_2\text{O}_3$ .....	.22	.40	.35	.14
$\text{FeO}$ .....		4.65	3.88	3.36
$\text{MgO}$ .....	.29	2.47	1.48	1.48
$\text{CaO}$ .....	.00	3.20	2.60	1.94
$\text{Na}_2\text{O}$ .....	3.96	1.29	1.23	.61
$\text{K}_2\text{O}$ .....	4.65	2.65	1.82	2.70
$\text{H}_2\text{O} + 100^\circ$ .....	.33		.32	
$\text{H}_2\text{O} - 100^\circ$ .....			.02	
$\text{TiO}_2$ .....	Trace.	.80	.65	
$\text{MnO}$ .....		.18	.06	.10
$\text{SO}_2$ .....	.23			
Total.....	99.90	100.37	99.96	100.49

I. Obsidian pebble. Analyst, J. E. Whitfield.

II. Obsidianite. Upper Weld, Tasmania. Analyst, W. F. Hillebrand.

III. Obsidianite. Near Hamilton, Victoria. Analyst, G. Ampl.

IV. Moldavite. Třebitzsch, Bohemia.

Although data are lacking regarding the mode of occurrence of this Colombian material, it is at once evident that it is a not unusual type of terrestrial obsidian.

(2) *Obsidian pebbles, Clifton, Arizona* (Cat. No. 53676).—These pebbles were received at the Museum in 1899 from Frank Keppler. There is apparently no question but what they are water-worn and corroded pebbles of ordinary obsidian. They are dark, smoky black

in color, and show under the microscope the characteristic black hair-like trichites. The surfaces are roughened by pits and grooves, and in addition the entire surface is shagreened.

(3) *Obsidian pebbles, near Marsh, Idaho* (Cat. No. 77784).—These pebbles, again, are of ordinary black obsidian, and were collected by Dr. W. Lindgren, of the U. S. Geological Survey, in gravel beds some  $4\frac{1}{2}$  miles north and 20 degrees west of Marsh. The surfaces are everywhere pitted and grooved, but the elongated, curvilinear, and lunar crater forms so characteristic of the billitonites are quite lacking. The surfaces are coated with a thin, mammillated crust, which is in part a secondary deposit of iron.

(4) *Obsidian pebble, High Rock Canyon, Nevada* (Cat. No. 35270).—This pebble is of coal black obsidian, only faintly translucent on the thin edges. The surface is etched in a manner suggestive of the billitonites, even to the nearly circular *lunar crater* forms, as they may be termed. The surface is also considerably abraded as though the pebble had been rolled about on a beach, and the bottoms of the grooves, or flutings, are coated with a dull, brown-red material, which seems to be an original constituent rather than an extraneous substance deposited from the water as was at first supposed. It is probably a devitrification product similar to that found in the lithophysæ of obsidians.

These same markings are roughly simulated on some large weathered obsidian pebbles sent by Dr. J. Aguilera from between Guajolote Hill and Cuyamaloya, Hidalgo, Mexico. (Cat No. 77802.)

(5) *Obsidian, near Myvatn, Iceland* (Cat. No. 77616).—Perhaps the most strikingly billitonite-like markings found on any of the terrestrial rocks are those on some obsidians brought by Dr. F. E. Wright from a flow at Hrafninnuhryggur, near Myvatn, in 1909. The material is a highly lustrous jet black glass, the outer surfaces of which are grooved and etched to a maximum depth of 2 or 3 mm. Not only are the lunar crater forms here in evidence, but there are also elongated, nearly straight grooves which, but for the position they occupy on the surface, might at first be thought to have been produced by the scoring of one mass against another while in the plastic condition. On one surface of this specimen are found only the minute circular pittings such as were described as occurring on the flattened areas of the specimens from Colombia.

To test the possibilities of a terrestrial origin for these markings, fragments of dark obsidian from near Reno, Nevada, and Yucca, in Mohave County, Arizona, were submitted for a few days to the action of dilute fluorhydric acid. The resultant forms are shown in the specimens numbered 88663.

Attention should be called to the fact that the markings on these pebbles and obsidians of known terrestrial origin more closely agree with

those on some of the tektites than do the tektites from various localities agree among themselves; and, further, that the etchings produced by action of fluorhydric acid are practically indistinguishable from the markings on some of the moldavites. Further than this, again, the markings on the tektites from various sources are so wholly unlike that it is impossible to conceive of their having a common origin, or to have been formed through the same agencies, and above all it is to be noted that in no case do they resemble the flutings which are characteristic of known meteorites. Further than this the smaller meteoric stones, those corresponding in size with the tektites, rarely if ever show pittings and flutings. It is only the larger forms apparently which hold their orientation for a sufficient length of time for flutings to develop. The smaller forms are mere rounded blebs as is abundantly illustrated by the hundreds of individuals constituting the Pultusk and other noted falls.

In the above no attempt is made to controvert the theory of a cosmic origin for these bodies. Until, however, such shall be seen to fall, their source or origin must be regarded as in doubt.



## APPENDIX B.

### EXAMPLES OF METALLIC IRON, IN PART ALLOYED WITH NICKEL, IN TERRESTRIAL ROCKS.

Metallic iron is quickly oxidized in a moist oxygen-rich atmosphere such as exists over a large part of the earth's surface and hence is rarely found, even if once formed, in terrestrial rocks. A few of the known occurrences are shown in the exhibits:

Native Iron in Basalt, Hessen, Germany (Cat. No. 88210).

Native Iron in Basalt, Nugsauk Peninsula, Greenland (Cat. No. 58479).

Josephinite, a native alloy of nickel and iron found in pebble form in the bed of a creek in Josephine County, Oregon. (Cat. No. 85976).





SMITHSONIAN INSTITUTION  
UNITED STATES NATIONAL MUSEUM  
**Bulletin 95**

---

THE FISHES OF THE WEST COAST OF  
PERU AND THE TITICACA BASIN

BY

BARTON WARREN EVERMANN  
*Director, Museum of the California Academy of Sciences*

AND

LEWIS RADCLIFFE  
*Assistant, United States Bureau of Fisheries*



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1917

**BULLETIN OF THE UNITED STATES NATIONAL MUSEUM.**

**ISSUED AUGUST 1, 1917.**

## ADVERTISEMENT.

The scientific publications of the United States National Museum consist of two series, the *Proceedings* and the *Bulletins*.

The *Proceedings*, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original, and usually brief, papers based on the collections of the National Museum, presenting newly acquired facts in zoology, geology, and anthropology, including descriptions of new forms of animals, and revisions of limited groups. One or two volumes are issued annually and distributed to libraries and scientific organizations. A limited number of copies of each paper, in pamphlet form, is distributed to specialists and others interested in the different subjects as soon as printed. The date of publication is printed on each paper, and these dates are also recorded in the tables of contents of the volumes.

The *Bulletins*, the first of which was issued in 1875, consist of a series of separate publications comprising chiefly monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, and catalogues of type-specimens, special collections, etc. The majority of the volumes are octavos, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable.

Since 1902 a series of octavo volumes containing papers relating to the botanical collections of the Museum, and known as the *Contributions from the National Herbarium*, has been published as bulletins.

The present work forms No. 95 of the *Bulletin* series.

RICHARD RATHBUN,  
*Assistant Secretary, Smithsonian Institution,*  
*In charge of the United States National Museum.*

WASHINGTON, D. C., April 18, 1917.

III



## TABLE OF CONTENTS.

---

	Page.
Introduction.....	1
Description of species.....	2
Family Heterodontidae.....	2
Genus Gyropleurodus.....	2
peruanus.....	2
Family Scylliorhinidae.....	3
Genus Halaelurus.....	3
chilensis.....	3
Genus Sphyrna.....	5
zygaena.....	5
Genus Mustelus.....	5
mento.....	6
abbotti.....	6
dorsalis.....	7
nigromaculatus.....	9
Genus Galeus.....	10
zyopterus.....	10
Family Squatinidae.....	11
Genus Squatina.....	11
squatina.....	11
Genus Rhinobatus.....	12
planiceps.....	12
Family Rajidae.....	13
Genus Raja.....	13
aguja.....	14
steindachneri.....	14
Genus Psammobatis.....	16
brevicaudatus.....	16
Genus Discopyge.....	16
tschudii.....	16
Genus Pteroplatea.....	16
crebripunctata.....	16
Genus Myliobatis.....	17
californicus.....	17
Genus Callorhynchus.....	18
callorhynchus.....	18
Family Clupeidae.....	19
Genus Potamalosa.....	19
notacanthoides.....	19
Genus Sardinella.....	20
sagax.....	20
Genus Harengula.....	21
stolifera.....	21

	Page.
Family Engraulidae .....	22
Genus Stolephorus .....	22
<i>tapirus</i> .....	23
<i>peruanus</i> .....	23
Genus Engraulis .....	23
<i>ringens</i> .....	23
<i>Nasus</i> .....	24
Family Leptocephalidae .....	24
Genus Leptocephalus .....	24
<i>multimaculatus</i> .....	24
<i>peruanus</i> .....	24
Genus Ophichthus .....	24
<i>grandimaculatus</i> .....	24
<i>callaensis</i> .....	25
<i>pacifici</i> .....	25
Genus Gymnothorax .....	26
<i>wieneri</i> .....	26
Family Characinidae .....	27
Genus Brycon .....	27
<i>atricaudatus</i> .....	27
Genus Astyanax .....	27
<i>peruanus</i> .....	27
Genus Lebiasina .....	29
<i>bimaculata</i> .....	29
Family Siluridae .....	30
Genus Galeichthys .....	30
<i>peruvianus</i> .....	31
<i>simonsi</i> .....	31
Genus Tachysurus .....	32
<i>equatorialis</i> .....	32
Genus Rhamdia .....	33
<i>gilli</i> .....	33
Genus Pimelodella .....	33
<i>yuncensis</i> .....	33
Genus Pygidium .....	33
<i>poeyanum</i> .....	34
<i>rivulatum</i> .....	34
<i>taenia</i> .....	35
<i>laticeps</i> .....	35
<i>oroyae</i> .....	35
<i>dispar</i> .....	35
<i>punctulatum</i> .....	35
<i>pardum</i> .....	36
<i>quechuorum</i> .....	36
Family Loricariidae .....	37
Genus Chaetostomus .....	37
<i>loborhynchus</i> .....	37
Genus Cyclopium .....	37
<i>simonsii</i> .....	37
Family Poeciliidae .....	37
Genus Aplocheilus .....	37
<i>peruanus</i> .....	37
Genus Orestias .....	37
<i>cuvieri</i> .....	38
<i>pentlandii</i> .....	39

## Family Poeciliidae—Continued.

Genus *Orestias*—Continued.

	Page.
<i>elegans</i> .....	40
<i>mülleri</i> .....	40
<i>tachudii</i> .....	40
<i>agassizii</i> .....	40
<i>owenii</i> .....	42
<i>olivaceus</i> .....	42
<i>albus</i> .....	42
<i>neveui</i> .....	42
<i>luteus</i> .....	42
<i>jussiei</i> .....	42
<i>incae</i> .....	42
Family Belonidae.....	43
Genus <i>Tylosurus</i> .....	43
<i>stolzmanni</i> .....	43
Family Hemirhamphidae.....	43
Genus <i>Hyporhamphus</i> .....	43
<i>unifasciatus</i> .....	43
Family Exocoetidae.....	43
Genus <i>Exocoetus</i> .....	44
<i>volitans</i> .....	44
Genus <i>Cypsilurus</i> .....	44
<i>speculiger</i> .....	44
Family Atherinidae.....	45
Genus <i>Atherinopsis</i> .....	45
<i>regius</i> .....	45
Genus <i>Protistius</i> .....	46
<i>semitilus</i> .....	46
Genus <i>Basilichthys</i> .....	47
<i>affinis</i> .....	47
<i>octavius</i> .....	49
Family Mugilidae.....	49
Genus <i>Mugil</i> .....	49
<i>cephalus</i> .....	49
Genus <i>Neomyxus</i> .....	51
<i>ciliilabis</i> .....	51
Family Sphyrænidae.....	51
Genus <i>Sphyræna</i> .....	51
<i>idiastes</i> .....	51
Family Polynemidae.....	52
Genus <i>Polydactylus</i> .....	52
<i>approximans</i> .....	52
Family Syngnathidae.....	53
Genus <i>Siphostoma</i> .....	53
<i>aciculare</i> .....	53
<i>blainvilliana</i> .....	53
Family Scombridae.....	53
Genus <i>Scomber</i> .....	54
<i>japonicus</i> .....	54
Genus <i>Sarda</i> .....	55
<i>chilensis</i> .....	55
Genus <i>Scomberomorus</i> .....	55
<i>sierra</i> .....	55

	Page.
Family Xiphiidae.....	56
Genus Xiphias.....	56
gladius.....	56
Family Carangidae.....	56
Genus Neptomenus.....	57
crassus.....	57
Genus Seriola.....	58
peruana.....	58
Genus Decapterus.....	58
scombrinus.....	58
Genus Trachurus.....	59
symmetricus.....	59
Genus Caranx.....	61
caballus.....	61
peruanus.....	62
Genus Vomer.....	62
setipinnis.....	62
Genus Selene.....	62
vomer.....	62
Genus Trachinotus.....	62
paloma.....	62
Family Stromateidae.....	63
Genus Leirus.....	63
peruanus.....	63
Genus Stromateus.....	64
maculatus.....	64
Family Cheilodipteridae.....	64
Genus Amia.....	64
retrosella.....	64
Family Serranidae.....	65
Genus Acanthistius.....	66
pictus.....	66
Genus Hemilutjanus.....	67
macrophthalmos.....	67
Genus Epinephelus.....	69
labriformis.....	69
Genus Alphestes.....	69
multiguttatus.....	69
Genus Mycteroperca.....	70
xenarcha.....	70
Genus Epelytes.....	71
punctatus.....	71
Genus Cratinus.....	72
agassizii.....	72
Genus Paralabrax.....	73
humeralis.....	73
callaensis.....	74
Genus Diplectrum.....	75
conceptione.....	75
Genus Prionodes.....	76
fasciatus.....	77
huascarii.....	78
peruanus.....	78
Genus Paranthias.....	78
furcifer.....	78

Family Serranidae—Continued.	Page.
Genus <i>Hemianthias</i> .....	79
<i>peruanus</i> .....	79
Family Haemulidae.....	80
Genus <i>Anisotremus</i> .....	80
<i>pacifici</i> .....	81
<i>scapularis</i> .....	81
Genus <i>Conodon</i> .....	82
<i>serrifer</i> .....	82
Genus <i>Brachydeuterus</i> .....	83
<i>nitidus</i> .....	83
<i>leuciscus</i> .....	84
Genus <i>Pomadasis</i> .....	85
<i>schyri</i> .....	85
<i>branicki</i> .....	86
Genus <i>Orthopristis</i> .....	87
<i>chalceus</i> .....	87
<i>modestus</i> .....	88
Genus <i>Isacia</i> .....	89
<i>conceptionis</i> .....	89
Family Sparidae.....	91
Genus <i>Calamus</i> .....	91
<i>taurus</i> .....	91
Family Gerridae.....	91
Genus <i>Xystaema</i> .....	91
<i>simillimum</i> .....	91
Genus <i>Gerres</i> .....	92
<i>peruvianus</i> .....	92
<i>periche</i> .....	93
Family Kyphosidae.....	94
Genus <i>Doydixodon</i> .....	94
<i>laevifrons</i> .....	94
Family Scaenidae.....	95
Genus <i>Cynoscion</i> .....	96
<i> analis</i> .....	96
<i>stolzmanni</i> .....	97
<i>phoxocephalus</i> .....	97
Genus <i>Larimus</i> .....	98
<i>pacificus</i> .....	98
Genus <i>Stellifer</i> .....	99
<i>minor</i> .....	99
Genus <i>Sciaena</i> .....	101
<i>fasciata</i> .....	101
<i>deliciosa</i> .....	102
<i>gilberti</i> .....	103
<i>starksi</i> .....	104
<i>wieneri</i> .....	105
Genus <i>Umbrina</i> .....	105
<i>xanti</i> .....	105
Genus <i>Menticirrhus</i> .....	106
<i>panamensis</i> .....	106
<i>cokeri</i> .....	107
Genus <i>Polyclemus</i> .....	108
<i>peruanus</i> .....	109

	Page
Family Oplegnathidae.....	1.0
Genus Oplegnathus.....	1.0
insignis.....	1.0
Family Latilidae.....	1.1
Genus Caulolatilus.....	1.1
princeps.....	1.1
cabezon.....	1.1
Family Pinguipedidae.....	1.2
Genus Pinguipes.....	1.2
chilensis.....	1.2
Family Cirrhitidae.....	1.3
Genus Cheilodactylus.....	1.3
variegatus.....	1.3
Family Aplodactylidae.....	1.4
Genus Aplodactylus.....	1.4
punctatus.....	1.4
Family Cichilidae.....	1.5
Genus Aequidens.....	1.5
rivulatus.....	1.5
Family Pomacentridae.....	1.6
Genus Chromis.....	1.6
atrilobatus.....	1.6
crusma.....	1.6
intercrusma.....	1.6
Genus Nexilorus.....	1.6
latifrons.....	1.6
Genus Abudedefduf.....	1.6
maxillaris.....	1.6
Family Labridae.....	1.7
Genus Bodianus.....	1.7
diplotaenioides.....	1.7
eclancheri.....	1.7
Genus Pimelometopon.....	1.7
darwinii.....	1.7
Genus Halichoeres.....	1.7
disipilus.....	1.7
Family Scaridae.....	1.8
Genus Xenocorpus.....	1.8
denticulatus.....	1.8
Family Balistidae.....	1.9
Genus Balistes.....	1.9
polylepis.....	1.9
Genus Canthidermis.....	1.9
adspersus.....	1.9
Family Tetracentridae.....	2.0
Genus Sphaerodius.....	2.0
annulatus.....	2.0
Family Gobiidae.....	2.1
Genus Philypnus.....	2.1
maculatus.....	2.1
Genus Mapo.....	2.1
superior.....	2.1
Genus Gobius.....	2.1
peruanus.....	2.1

	Page.
Family Echeineididae.....	135
Genus Echeineis.....	135
remora.....	135
Family Scorpænidæ.....	136
Genus Sebastichthys.....	136
chamaco.....	136
darwini.....	137
Genus Scorpæna.....	137
histrio.....	137
Genus Pontinus.....	138
dubius.....	138
Family Agriopodidae.....	139
Genus Agriopus.....	139
peruvianus.....	139
Family Pleuronectidae.....	140
Genus Paralichthys.....	140
adpersus.....	140
woolmani.....	140
Genus Citharichthys.....	141
gilberti.....	141
Genus Etropus.....	142
ectenes.....	142
Family Blenniidae.....	142
Genus Lepisoma.....	143
xanti.....	143
philippi.....	144
peruviana.....	145
microcirrhis.....	146
Genus Blennius.....	146
tetranemus.....	146
Genus Hycleurochilus.....	146
paytensis.....	146
Genus Alticus.....	146
gigas.....	146
Genus Salaria.....	147
rubropunctatus.....	147
Genus Emblemaria.....	147
hudsoni.....	147
Family Ophidiidae.....	149
Genus Genypterus.....	149
blacodes.....	149
chilensis.....	150
Family Brotulidae.....	151
Genus Brotula.....	151
maculata.....	151
Genus Porichthys.....	152
afueræ.....	152
Family Gobiesocidae.....	153
Genus Gobiesox.....	153
sanguineus.....	153
Genus Arbacia.....	155
pyrrhocincla.....	155
hieroglyphica.....	155
Family Merlucciidae.....	156
Genus Merluccius.....	156
gayi.....	156
Index.....	159



# THE FISHES OF THE WEST COAST OF PERU AND THE TITICACA BASIN.

---

BY BARTON WARREN EVERMANN,

*Director, Museum of the California Academy of Sciences,*

and

LEWIS RADCLIFFE,

*Assistant, United States Bureau of Fisheries.*

---

## INTRODUCTION.

While engaged in 1907 and 1908 under the auspices of the Peruvian Government in an investigation of the fisheries and fishery resources of Peru, Dr. Robert E. Coker embraced the opportunity to make collections of the fishes inhabiting the streams and coastal waters of that country.

The principal localities in which collections were made are Ancon, Eten, Callao, Capon, Chimbote, Chincha Island, Guanape North Island, Lake Titicaca, Lima market, Lobos de Afuera, Lobos de Tierra, Mollendo, Pacasmayo, Paita, Rimac River, Santa Rosa Island, Tumbes and Tumbes River, and Ballestas Island. The largest number of species (28) was obtained at Lobos de Afuera.

These collections were turned over to the present writers for study and the preparation of a report thereon. They represent, in the aggregate, the largest and most important collection of fishes ever obtained in those waters. The total number of specimens somewhat exceeds 500. The number of species represented is 120, of which 12 appear to be new.

In the present report the authors have included not only the species represented in Doctor Coker's collections, but all others previously actually recorded from the Pacific coast and drainage of Peru and from the Titicaca Basin. This brings the total number of species known from Peruvian waters to 187.

Through the generosity of the Peruvian Government the authors are able to include illustrations from original drawings of 40 of the species.

The collections are now deposited in the United States National Museum. The original drawings were made by Mr. Kako Morita and Miss Violet Dandridge.

The common species names given are local or vernacular names supplied by Doctor Coker.

The writers take this opportunity to express their appreciation of aid rendered and courtesies extended to them by the Hon. Eduardo Higginson, Peruvian consul general at New York, and to Dr. Robert E. Coker, director of the Fairport (Iowa) Biological Laboratory of the Bureau of Fisheries.

Acknowledgement should be made to Señor Don Carlos Larrabure y Correa, director of public works for the Peruvian Government, whose breadth of interest and effective energy have made possible the study and report on the collections in the present form.

#### DESCRIPTION OF SPECIES.

### Family HETERODONTIDAE.

#### THE BULLHEAD SHARKS.

Not until now has any species of this family been reported from Peruvian waters. Doctor Coker's collections contains a single specimen which does not belong to any previously described species.

#### Genus GYROPLEURODUS Gill.

##### 1. GYROPLEURODUS PERUANUS, new species.

#### GATO; SUÑO.

#### Plate 1, fig. 1.

A single specimen, the type, Cat. No. 77691, U. S. Nat. Mus. (field No. 09509), 56.5 cm. in length, from Lobos de Tierra.

Length of head to branchial region, 5.25 in total length; depth 5.6; eye 6.75 in head; interocular 2.07; snout 1.9; length of first gill opening 3.66; length of fifth gill opening one-half that of first. Body robust anteriorly, tapering posteriorly; caudal peduncle slender, its depth about one-fifth length of head; head short and stout, nearly as broad as long; snout blunt, ridges from tip of snout converging for half the distance to eyes, thence diverging and merging into the strong supraorbital ridges, the latter terminating just behind the eyes; interorbital concave. Teeth in front of jaws tricuspid, the middle cusps strongest, arranged in about six converging rows; behind these on the sides of the jaws there are five oblique rows of elongate, carinate teeth, each cross series composed of five teeth, the whole patch rhomboidal in outline; eyes small, in a groove between the overhanging supraorbital ridge and the tumid cheek. Origin of first dorsal posterior in its insertion to the vertical from posterior base of pectoral; distance from tip of snout to its insertion 2.75 in total length of body; distal portion rounded and not lunate as in *G. galeatus*, its height 2.62 in length of head; length of base, 2.2; first dorsal spine very stout and blunt, its height one-

half that of soft dorsal; distance from insertion of first to second dorsal, 3.81 in total length; height of second dorsal, 3.1 in head; base 2.8; height of spine, 1.4 in that of fin, distal portion of fin truncate; distance from insertion of second dorsal to tip of caudal, 2.76 in total length; caudal broad, a notch at tip, opposite last vertebra; pectoral very large, the broad truncate distal portion extending beyond vertical from insertion of first dorsal, pectoral longer than head, 4.42 in total length; distance from tip of snout to insertion of pectoral, 4.8 in total length; ventrals large, inserted slightly behind the vertical from posterior base of first dorsal, length 1.8 in length of pectoral; distance from insertion of pectorals to insertion of ventrals 3.64 in total length; insertion of anal under vertical from middle of free part of the backward prolongation of second dorsal, its length 1.66 in head, its tip extending beyond the origin of the caudal. Scales of the back and sides black and olivaceous, the greater number of those on back black, giving the dorsal surface a much darker coloring than sides; belly light olivaceous; body and fins everywhere covered with numerous black spots of varying sizes, their diameter less than horizontal diameter of eye; six indistinct dark crossbands on back, the first above gill openings, the second in front of dorsal, the third under posterior end of first dorsal, fourth in front of origin of second dorsal, the fifth under second dorsal, and the sixth on caudal peduncle in front of base of caudal; fins similar in coloration to body.

Color in life, "a dirty brown, blotched and spotted with black; ventral surface pale, but spotted with black."

This species appears to be most closely related to the poorly described *G. quoyi*, but differs in coloration, in insertion of anal, and relative size of pectoral. In *G. francisci*, the dorsal is more anterior in its insertion, the anterior gill-slit is shorter, and the black spots are smaller.

## Family SCYLLIORHINIDAE.

### THE CAT SHARKS.

#### Genus HALAELURUS Gill.

#### 2. HALAELURUS CHILENSIS (Guichenot).

##### PEJE-GATO.

*Scyllium chilense* GUICHENOT in Gay, Hist. Chile, Zool., vol. 2, 1848, p. 362.—

GÜNTHER, Cat., Fish. Brit. Mus., vol. 8, 1870, p. 405.—PHILIPPI, Ann. Univ. Chile, vol. 71, 1887, p. 556, pl. 7, fig. 4.—VAILLANT, Miss. Sci. Cape Horn, Zool. Poiss., 1891, p. 10, pl. 1, figs. 1-2.

*Scylliorhinus chilensis* DELFIN (part), Cat. Peces de Chile, 1901, p. 15.

*Scylliorhinus chilensis* REGAN, Synopsis Sharks Fam. Scylliorhinidae, Ann. Mag. Nat. Hist., ser. 8, vol. 1, 1908, p. 462.

Two specimens, a female, field No. 09702, and a male, field No. 09710, respectively 50.7 and 55.7 cm. in length, from Mollendo.

Following are the dimensions of these two individuals:

	Female.	Male.
	mm.	mm.
Total length.....	607	557
Tip of snout to origin of first dorsal.....	210	240
Base of first dorsal.....	42	39
Posterior base of first dorsal to origin second dorsal.....	65	73
Base of second dorsal.....	47	52
Base of second dorsal to origin caudal.....	57	55
Length of caudal.....	86	98
Length anterior margin first dorsal.....	50	58
Length anterior margin second dorsal.....	59	61
Tip of snout to eye.....	29	34
Eye.....	12½	14
Interorbital.....	31	35
Tip of snout to first gill-opening.....	76	90
Tip of snout to nearest point of mouth.....	19	20
Angle of mouth to center of upper lip.....	31	37
Length of labial fold of upper lip.....	12	17
Length of labial fold of lower lip.....	13	17
Tip of snout to origin pectoral.....	91	105
Length of pectoral.....	54	60
Origin of pectoral to origin of ventral.....	104	110
Length of ventral.....	46	61
Origin ventral to origin anal.....	203	224
Length of anal.....	40	41
Base of anal.....	36	39

Head broad and depressed; snout blunt, projecting little beyond mouth; mouth broad, the arch greater in male than in female; teeth small, with indistinct lateral cusps; nasal valves not confluent, separated from each other by a considerable interspace, with a downward twist, the outer border broadly rounded, the inner somewhat notched; no cirrus; each jaw with a labial fold extending from angle of mouth for about one-half its length; caudal peduncle long and slender.

Origin of dorsal opposite posterior base of ventrals; origin of second dorsal opposite middle of ventrals; first dorsal somewhat higher in male than female. Some of the granulations along ridge of back on either side of median line somewhat larger than the others; a ridge of enlarged tubercles above eye.

Color of male in spirits, back bluish black, becoming yellowish on ventral surface; dorsal surface crossed by seven broad rhombic black transverse blotches, first over origin of pectoral, second above tip of pectoral, third under first dorsal, fourth midway between first and second dorsal, fifth under second dorsal, sixth midway between second dorsal and base of caudal, and seventh across base of caudal; head, back, sides, and fins with large black spots; an indistinct dark band across head, through eyes; some lighter yellowish spots on sides. In the female, the interspace between the black crossbands on back is much lighter, of a yellowish tinge, similar to belly.

In these individuals the anterior nasal valves are not acutely pointed as stated by Regan and figured by Vaillant, but rounded.

**Genus SPHYRNA Rafinesque.**

**3. SPHYRNA ZYGAENA (Linnaeus).**

**CRUZ.**

*Squalus zygaeno* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 234; Europe; America.  
*Zygaena malleus* STORER, Fish. Mass., 1867, p. 238.

*Sphyrna zygaena* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 45.—GILBERT and STARKS, Fishes of Panama Bay, Mem. Cal. Acad. Sci., vol. 4, 1904, p. 13.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 763; Callao, Peru.

?*Zygaena peruana* PHILIPPI, Ann. Univ. Chile, vol. 71, 1887, p. 545, pl. 2, fig. 2.

?*Sphyrna peruana* ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 328.—DELFIN, Cat. Peces de Chile, 1901, p. 18.

Tail and head, field Nos. 09510-11, of a hammerhead shark 100 cm. in length from Lobos de Tierra.

The following dimensions of this individual were taken by Doctor Coker:

	cm.
Snout to origin of first dorsal.....	28
Base of first dorsal.....	9
Anterior margin of first dorsal.....	15
Distance between first and second dorsals.....	24.5
Base of second dorsal.....	3
Anterior margin of second dorsal.....	4
Second dorsal to tip of caudal.....	38.5
Distal lobe of caudal.....	30
Anterior margin of ventral.....	4
Anterior margin of pectoral.....	12
Width of hammer.....	26.5
Eye to eye around snout.....	27.5
Antero-postero length of hammer.....	6-7.5
Anal to tip of caudal.....	40

**Genus MUSTELUS Cuvier.**

**KEY TO SPECIES.**

- a<sup>1</sup>. First dorsal inserted anteriorly, the distance between origin of first dorsal and tip of snout about six and two-thirds in total length. Teeth transverse, with a low median keel.....*mento*, p. 6.
- a<sup>2</sup>. First dorsal situated farther caudad, the distance from tip of snout to origin of first dorsal less than 4 in total length.
  - b<sup>1</sup>. Coloration variable; olivaceous, flecked with white or dusky, with about 15 darker crossbands; body robust, snout rather blunt.....*abbotti*, p. 6.
  - b<sup>2</sup>. Coloration plain olivaceous; head strongly depressed, body slender; snout pointed.....*dorsalis*, p. 7.
  - b<sup>3</sup>. Coloration olivaceous, back and sides with black spots; body robust, head not strongly depressed; snout blunt, thick.....*nigromaculatus*, p. 9.

4. *MUSTELUS MENTO* Cope.

*Mustelus mento* COPE, Proc. Amer. Philos. Soc. Phila., 1877, p. 47 (31); Pacasmayo Bay.

*Mustelus edulis* PEREZ, C. Estudio Sobre Algunos Escualos Chile, 1886, p. 4.—PHILIPPI, Ann. Univ. Chile, vol. 71, 1887, p. 547.

*Galeus mento* ABBOTT, Marine Fishes of Peru in Proc. Acad. Nat. Sci. Phila., 1899, p. 326.

*Galeorhinus mento* DELFIN, Cat. Peces de Chile, 1901, p. 17.—PORTER, Breve Nota de Ictiologia, Revista Universitaria, Lima, vol. 8, 1909, p. 138.

From the Pacific Ocean at Pacasmayo, Peru.

5. *MUSTELUS ABBOTTI*, new species.

TOLLO.

Plate 1, fig. 2.

*Galeus dorsalis*, ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 327; Callao; not *Mustelus dorsalis* Gill.

*Type*.—Cat. No. 77696, U.S.N.M., a female, 55 cm. in length (field No. 09115) and a paratype, also a female, No. 09107, 46.5 cm. in length, taken with gill net, fishing in the surf at La Ventanilla between Ancon and Callao.

One specimen (paratype), a young female, field No. 09532, 32 cm. in length, from Lobos de Tierra.

Following are the dimensions of the type and paratypes:

	Type.	Paratype.	Paratype.
	mm.	mm.	mm.
Total length.....	550	465	320
Distance from tip of snout to first gill slit.....	103	87	57
Distance from tip of snout to eye.....	47.5	42	27.5
Diameter of eye.....	15	13	10.5
Length of spiracle.....	5	5	3.5
Breadth of head.....	57	49	33
Depth of head.....	35	28	19
Interorbital (bone).....	30	24	15
Distance from tip of snout to front of mouth.....	37	30	21
Distance between nostrils.....	16	13	9.5
Distance between angles of mouth.....	33	28	20
Distance from tip of snout to base of dorsal fin (not including the fleshy ridge).....	170	140	93
Base of first dorsal.....	67	55	35
Length of anterior margin of first dorsal (not including broad fleshy base).....	59	51	31
Distance from origin first dorsal to origin second dorsal.....	177	136	96
Base of second dorsal.....	60	47	29
Length of anterior margin of second dorsal.....	48	42	27
Distance from origin second dorsal to base of caudal.....	114	100	62
Length of upper caudal lobe.....	105	85	58
Distance from base of notch on lower lobe to its insertion..	73	60	42
Distance from tip of snout to insertion of pectorals.....	119	107	62
Length of anterior margin of pectorals.....	83	67	44
Breadth of distal margin.....	69	52	34
Distance from base pectorals to ventral base.....	125	110	68
Distance from base ventrals to anal base.....	105	94	66
Base of anal.....	30	28	18.5
Distance from insertion of anal to base caudal.....	78	60	39
Depth of body.....	70	56	37

Body rather strongly arched, caudal peduncle slender; head broad, depressed; snout rounded; spiracle large, 3 in eye; margins of each side of mouth slightly concave; teeth blunt, paved, without cusps, differing greatly in appearance from those of the types of *Mustelus dorsalis*, which have a well-developed cusp on each tooth; labial folds well developed, the outer 1.8 in the distance from its tip to symphysis of lower jaw.

First dorsal high, distal margin slightly concave, tip of posterior lobe reaching vertical from base of ventral; second dorsal smaller but similar in shape to the first dorsal; upper caudal lobe 5.12 in total length; lower lobe slightly concave, anal similar to second dorsal in shape but much smaller, inserted under middle of second dorsal; pectoral large, distal margin straight; ventrals with their inner margin lengthened, longer than outer margin, tips reaching more than half distance to base of anal.

Color in alcohol, olivaceous, tinged with yellowish on ventral surface; dorsal surface flecked with white.

Coloration of field No. 69107 similar to the type.

Color of small male from Lobos de Tierra, silvery plumbeous on back and sides, ventral surface paler; back crossed by about 15 black or dusky crossbands, these reaching lateral line; six of these crossbands in front of the dorsal.

This species has the general form of *Mustelus dorsalis* (the types of which we have examined), differing in having the body and head deeper, and the snout less pointed in individuals of the same size; the lower caudal lobe anterior to the notch, shorter, 7.52 to 7.75 in the total length (6.62 to 6.68 in types of *M. dorsalis*) and in the well-marked differences in the character of the teeth and coloration. The description of individuals from Callao identified by Abbott as *G. dorsalis* agrees in all essential characters with these specimens.

Named for James Francis Abbott in recognition of his valuable contributions to our knowledge of the ichthyology of Peru.

#### 6. MUSTELUS DORSALIS GILL.

Plate 1, fig. 3; plate 2, fig. 1.

#### TOLLO.

*Mustelus dorsalis* GILL, Proc. Acad. Nat. Sci. Phila., 1864, p. 149; Panama. *Galeus dorsalis* JORDAN and EVERMANN, Fishes North and Mid. Amer., 1896, vol. 1, p. 30.—GILBERT and STARKS, Fishes of Panama Bay, Mem. Cal. Acad. Sci., vol. 4, 1904, p. 7, pl. 1, fig. 2, 2a. (Not of Abbott.)

One specimen, a male, field No. 09435, 50 cm. in length, from Pacasmayo.

Following are the dimensions of this specimen:

	mm.
Total length.....	500
Tip of snout to eye.....	42
Interorbital .....	24
Eye .....	13
Tip of snout to anterior margin of mouth.....	32.5
Tip of snout to anterior gill slit.....	91
Tip of snout to origin of first dorsal.....	154
Base of first dorsal.....	58
Height of first dorsal.....	46
Origin of first dorsal to origin of second dorsal.....	158
Origin of second dorsal to base of caudal.....	101
Tip of snout to origin of pectoral.....	112
Length of pectorals .....	81
Origin of pectorals to origin of ventrals.....	119
Origin of ventrals to origin of anal.....	105
Length of lower caudal lobe anterior to notch.....	67
Breadth of head .....	55
Depth of head between eyes.....	25
Depth of body .....	47
Length of spiracle .....	3.5

Body low, elongate; head broad, strongly depressed; eyes small; spiracle very small, mouth angular; labial folds well developed; teeth with the single median cusp, rather blunt. Dorsal slightly falcate, posterior lobe scarcely reaching vertical from origin of ventrals; second dorsal similar to first, but smaller; upper caudal lobe 5.38 in total length; anal inserted under middle of second dorsal; pectoral broad, tip reaching nearly to posterior base of first dorsal.

A careful comparison of this individual with the type of *M. dorsalis* reveals the following slight differences: The breadth of the head is a little greater, the length of the lower caudal lobe anterior to the notch is shorter; the insertion of the anal is slightly more caudad. The type and paratypes of *dorsalis* are badly shrunk and for this reason the value of these differences is questionable.

Ten embryos, 6 males and 4 females, field No. 09536, 7.8-9.1 cm. long, from Lobos de Tierra. Doctor Coker's notes say that these embryos are from 2 plain sharks measuring about 80 cm. in length. One bore 5, the other 6, embryos. These are too small for certain identification, but agree quite closely with this species. The remnant of the yolk-sac, closely resembling a placenta, still remains in some of these specimens. This character is figured by Waite in the young of *Galeus australis*.<sup>1</sup>

<sup>1</sup> Sci. Res. New Zealand Govt. Trawling Exped., 1907, Records Cant. Mus., vol. 1, 1909, No. 2, pl. 15.

7. *MUSTELUS NIGROMACULATUS*, new species.

## TOLLO.

## Plate 2, fig. 2.

Two specimens, males, the type, Cat. No. 77699 U.S.N.M., 50 cm. in length, and a paratype, 51 cm. in length (field Nos. 09527 and 09533), from Lobos de Tierra.

Following are the dimensions of the type and paratype:

	Type.	Para- type.
	mm.	mm.
Total length.....	500	510
Distance from tip of snout to first gill slit.....	93	91
Distance from tip of snout to eye.....	42	42
Diameter of eye.....	13	12
Length of spiracle.....	4	3.5
Breadth of head.....	58	56
Depth of head.....	34	31
Interorbital.....	27	25
Depth of body.....	67	68
Distance from tip of snout to front of mouth.....	29	29
Distance between nostrils.....	16.5	18
Distance between angles of mouth.....	35	35
Distance from tip of snout to base of dorsal fin (not including the fleshy ridge).....	160	165
Base of first dorsal.....	64	61
Length of anterior margin of first dorsal (not including broad fleshy base).....	53	48
Distance from origin of first dorsal to origin second dorsal.....	150	162
Base of second dorsal.....	55	50
Length of anterior margin of second dorsal.....	49	39
Distance from origin of second dorsal to base of caudal.....	96	91
Length of upper caudal lobe.....	99	103
Distance from insertion of lower caudal lobe to notch.....	75	80
Distance from tip of snout to insertion of pectorals.....	106	102
Length of anterior margin of pectorals.....	75	69
Breadth of distal margin.....	68	53
Distance from base of pectorals to base of ventrals.....	130	130
Distance from base of ventrals to base of anal.....	90	96
Base of anal.....	30	30
Distance from insertion of anal to base of caudal.....	57	56

Body robust, rather deep; snout blunt, thick, and fleshy; head slightly depressed; mouth wider, more evenly rounded, and nearer tip of snout than in the related species from Peru; teeth with a central blunt or more or less pointed cusp, the majority of those in upper jaw being provided with a lateral cusp posteriorly and a shoulder toward the symphysis, having the general appearance of a cusp worn away, those on the lower jaw approaching more nearly the teeth of *M. abbotti*, the lateral cusps as a rule being less pro-

nounced and lower than those in upper jaw, the central cusp being much blunter and the lateral cusps entirely or nearly lacking in the teeth in front of jaws near symphysis.

The shape of the fins is essentially the same as in *M. abbotti*, from which the present species may be recognized by the marked difference in coloration and the character of the teeth. The first dorsal and the ventrals are inserted farther caudad than in *abbotti*, but have the same relative position with reference to each other; the caudal is longer, thereby lessening the distance between the base of caudal and the second dorsal and anal, the former reaching to within one-half the length of snout to upper base of caudal and the latter to within less than half a diameter of eye to base of lower caudal lobe. The caudal is one-fifth of the total length. The claspers do not reach to the tips of the ventrals.

Color in alcohol, dusky olivaceous, lighter on ventral surface; scattered black spots on back, sides, and base of dorsals.

The paratype agrees closely with the type, the teeth being somewhat blunter, and there are fewer black spots on the sides. Color in life, body with black spots very irregularly disposed, in our specimens more numerous and larger on the left side than on the right.

#### Genus GALEUS Rafinesque.

##### S. GALEUS ZYOPTERUS (Jordan and Gilbert).

##### TOLLO.

*Galeorhinus zyopterus* JORDAN and GILBERT, Synopsis Fishes North Amer., Bull. U. S. Nat. Mus., 16, 1882 (1883), p. 871; San Pedro, Cal.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 82; vol. 4, 1900, pl. 4, fig. 15.

*Galeus zyopterus* JORDAN, Guide to Study of Fishes, vol. 1, 1905, p. 541, fig. 334.

Three specimens, field Nos. 09421, 09423, 09436, respectively, 36, 37.5, and 40.5 cm. long, from Pacasmayo, taken with hook and line from the pier and in the bay.

Following are the dimensions of the largest example:

	mm.
Total length .....	405
Distance from tip of snout to first gill-slit .....	72
Distance from tip of snout to eye .....	30
Diameter of eye .....	15
Length of spiracle .....	4
Interorbital .....	22
Depth of body .....	41
Distance from tip of snout to front of mouth .....	28
Distance between nostrils .....	15
Distance between angles of mouth .....	31
Distance from tip of snout to base of first dorsal .....	120

	mm.
Base of first dorsal.....	31
Length of anterior margin of first dorsal.....	31
Distance from origin of first dorsal to origin of second dorsal.....	118
Length of anterior margin of second dorsal.....	17
Distance from origin of second dorsal to base of caudal.....	60
Length of upper caudal lobe.....	91
Distance from tip of snout to base of pectorals.....	82
Length of anterior margin of pectorals.....	54
Breadth of distal margin of pectorals.....	40
Distance from base of pectorals to base of ventrals.....	110
Distance from base of ventrals to base of anal.....	62
Base of anal.....	18
Distance from insertion of anal to base of caudal.....	47
Distance from insertion of caudal to notch.....	56
Length of anterior margin of lower caudal lobe.....	42

Body slender; snout long, depressed; eye large; spiracle moderate; each tooth with a strong, sharp cusp directed backward, below and behind this are 1 to 4 smaller cusps or serrations, those at symphysis of jaw slightly smaller, several of the teeth tricuspid as in *Triakis*; mouth rounded at tip; nostrils nearer mouth than tip of snout. Fins small; second dorsal much smaller than the first, caudal long, 4.45 in total length; anterior part of lower caudal lobe elongate; anal smaller than second dorsal; ventrals small; pectoral elongate.

Color in alcohol, back and sides, dorsals and upper surface of pectorals, blackish, belly grayish silvery.

These individuals from Peru agree very well with the type of this species with which we have compared them.

### Family SQUATINIDAE.

#### THE ANGEL SHARKS.

#### Genus SQUATINA Duméril.

#### 9. SQUATINA SQUATINA (Linnaeus).

##### ANGELOTA.

*Squalus squatina* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 233; Coast of Europe.

*Squatina californica* AYRES, Proc. California Acad. Sci., 1859, p. 29; San Francisco.

*Rhina squatina* GÜNTHER, Cat. Fish. Brit. Mus., vol. 8, 1870, p. 430.

*Squatina squatina* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1896, p. 58.

One specimen, a male, field No. 09517, 56 cm. long, from Lobos de Tierra.

Following are the measurements of this specimen:

	mm.
Total length.....	560
Tip of snout to base of pectoral.....	123
Tip of snout to origin of ventrals.....	212

Tip of snout to origin of first dorsal.....	370
Origin of first dorsal to origin of second dorsal.....	61
Origin of second dorsal to tip upper caudal lobe.....	125
Snout.....	85
Distance between eyes.....	54
Space between spiracles.....	49
Tip of snout to anus.....	265
Total length, outer border of pectoral.....	175
Distance between angles of mouth.....	82
Width of free portion of caudal.....	90
Base of first dorsal.....	26
Height of first dorsal.....	53
Base of second dorsal.....	23
Height of second dorsal.....	46
Diameter of eye.....	10

Body compressed; snout rounded; eyes small, inserted near margin of disk; pectorals broad, distal margin truncate; ventrals narrower, truncate; dorsals small, narrow at base, rather high, of about equal size; caudal triangular, the lower lobe the longer; skin rough; enlarged prickles along the median line of the back; small patches in front of and behind the eyes, and two small patches on tip of snout on either side of median line of head; a single enlarged prickle, at a distance equal to diameter of eye from spiracle toward median line of head.

Color in alcohol, ashy gray, finely mottled and blotched with olive; dusky areas on dorsal and caudal, larger and irregular in form; ventral surface white.

#### Genus RHINOBATUS Bloch and Schneider.

##### 10. RHINOBATUS PLANICEPS Garman.

##### GUIATARRA.

Plate 2, fig. 3.

*Rhinobatus planiceps* GARMAN, Bull. Mus. Comp. Zool., 1880, p. 168; Peru; Galapagos; Proc. U. S. Nat. Mus., vol. 3, 1880, p. 520; Païta, Callao, and Galapagos Islands.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 64.

One specimen, field No. 09508, 76.3 cm. long, and five specimens, field No. 09535, 19 to 21 cm. long, from Lobos de Tierra.

Dimensions of largest individual:

Total length.....	763
Width of disk.....	267
Distance from tip of snout to end of ventrals.....	408
Distance from tip of snout to end of vent.....	315
Distance from tip of snout to end of mouth.....	120
Distance from tip of snout to end of nostrils.....	98
Distance from tip of snout to end of eye.....	100

Distance from tip of snout to end of first dorsal.....	mm. 440
Base of first dorsal.....	89
Distance between dorsals.....	78
Base of second dorsal.....	43
Distance from second dorsal to base of caudal.....	42
Length of caudal.....	121
Width of interorbitals.....	40
Height of dorsals.....	75

Body rhombic, width of disk 1.52 in its length; head broad and flat; snout broad, its tip rounded; ridges of rostral cartilage close together, dilated at tip, spiracle immediately behind and smaller than eye, only a single fold on the posterior border, as well developed in the young as in the adult; mouth straight; anterior nasal valve single, not dilated; posterior two-lobed; an irregular row of rather stout spines on median line of back from occiput to first dorsal, several spines between dorsals; the rows of spines on ridges of rostral cartilage, over eyes and on median line of caudal peduncle, absent or greatly reduced, approximating the prickles in size and appearance; two small patches of spines on shoulder. Dorsals triangular; anterior borders of pectorals straight, outer lobe rounded, hinder edge reaching to opposite middle of vent; outer angle of ventrals rounded, tip acute.

Color, brownish olive on back, slaty white on belly; several large indistinct dark brown areas, symmetrically arranged on either side of median line of back.

Color in life, light olive green with numerous dark blotches symmetrically placed, but of vague outline. First and second dorsal, caudal and outer parts of ventrals and pectorals with the least tinge of rufous; ventral surface white, except outer border of pectorals and in lesser degree the outer border of the ventrals.

Regarding the embryos, Mr. Coker states that they were taken from a "Guiatarra," 98 cm. in length. Eight in all were taken from this fish.

### Family RAJIDAE.

#### THE SKATES

##### KEY TO GENERA REPRESENTED.

- $\alpha^1$ . Disk rhombic; pectoral fins not extending forward to the extremity of snout..... *Raja*, p. 13.  
 $\alpha^1$ . Disk circular; snout short and overlapped by the anterior portions of the pectoral fins which form the foremost part of the disk..... *Psammobatis*, p. 16.

#### Genus RAJA (Artedi) Linnaeus.

##### KEY TO SPECIES REPRESENTED.

- $\alpha^1$ . Distance from tip of snout to line connecting tips of pectorals 2 in breadth of disk; enlarged spines along median dorsal line of tail 25 to 30; dorsal surface of tail covered with stout prickles; rostral angle 52 degrees.

*aguja*, p. 14.

- c'. Distance from tip of snout to line connecting tips of pectorals about 2.3 in breadth of disk; enlarged spines along median dorsal line of tail 10 to 12; rest of tail smooth; rostral angle 54 degrees.-----*steindachneri*, p. 14.

#### 11. RAJA AGUJA Kendall and Radcliffe.

*Raja aguja* KENDALL and RADCLIFFE, Mem. Mus. Comp. Zool., vol. 35, No. 3, p. 78, pl. 1, fig. 1-2, April, 1912; *Albatross* station 4653, near Point Aguja, Peru.

#### 12. RAJA STEINDACHNERI Delfin.

##### PLATILLO; RAYA.

*Raja chilensis* STEINDACHNER, Fauna Chilensis, 1898, p. 332, pl. 31, fig. 15; Iquique (not *R. chilensis* Gay, Hist. Chile, Zool., vol. 2, 1848, p. 367).—

ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 328.

*Raja steindachneri* DELFIN, Cat. Peces de Chile, 1901, p. 28.

*Raja burgeri* DELFIN, Rayas Nuevas Chilenas, Rev. Chil. Hist. Nat., Ano VI, 1902, p. 267, pl. 12; Coquimbo.

. The collection contains two specimens of this species, a female (field No. 09704) from Mollendo, and a male (field No. 09721) from Chimbote, where it was called "Raya."

Following are the measurements of these two specimens:

	Female.	Male.
	mm.	mm.
Total length.....	390	393
Length of disk.....	235	235
Width of disk.....	280	295
Tip of snout to front of eye.....	52	51
Distance between eyes.....	31	30
Interorbital.....	25	24
Longitudinal diameter of eye.....	12	12
Length of spiracle aperture.....	14	13.5
Height of first dorsal.....	8	9
Base of first dorsal.....	17	17.5
Distance between first and second dorsal.....	6	5.5
Height of second dorsal.....	9.5	10
Base of second dorsal.....	26	26.5
Tip of snout to nostrils.....	39	37
Tip of snout to center of mouth.....	44	43
Tip of snout to anus.....	211	203
Tip of snout to fifth branchial aperture.....	130	130
Breadth of mouth.....	39	41
Length of tail.....	162	178
Breadth of tail at its base.....	67	84
Length of clasper in male.....	.....	118

In the female there is a broad band of minute prickles barely protruding through the skin on the anterior dorsal border of the disk, beginning slightly in advance of eyes and extending backward to within two-sevenths distance from tip of snout to broadest part

of disk; another narrow band of closer set, slightly stronger prickles around spiracle behind eyes; concave interorbital space with scattered prickles; a narrow patch beginning opposite the first branchial aperture and extending along the border of the disk to the tip of snout; in all the patches the prickles are recurved so that they feel smooth if the finger is passed backward; a short stout spine before and another behind eye on interorbital ridge; a short row of similar spines on median line of back behind spiracle; a patch of similar spines in center of posterior projecting lobe of pectoral; a row of 10 stout triangular spines on median line of tail in front of dorsal; a single stout spine between dorsals and a row of prickles on median line of back; a continuation of spines on tail.

Disk opposite eyes, convex, then becoming slightly concave; posterior border rounded; pectoral rays about 70.

Color, in alcohol, back brownish, becoming olive-gray on the margins of the disk; ventral surface grayish white.

In the male the prickles are stronger; on the median line of the back anteriorly there is a single enlarged spine surrounded by an elongate patch of prickles; there are 12 stout spines on median line of tail in front of dorsal, 1 between dorsals; in front of spines on tail there is a patch of prickles extending along median line of back; no group of spines on posterior lobe of pectoral; opposite broadest part of disk and nearly parallel with it near the margin there is a double row of stout recurved spines, 16 spines in each row; on the right side there are several spines forming a third row; pectoral rays about 70.

Color in alcohol, back brown, with olive spots about size of eyes tending to form rows parallel with median line of back; the brown fading out to olive-gray on borders of disk; ventral surface grayish-white.

The more pointed snout, the stout spines near pectoral border, and absence of group on posterior lobe, the difference in coloration, and the elongate claspers reaching beyond origin of first dorsal serve to distinguish the two. A greater difference lies in the remarkable character of the teeth. In the female they are pavementlike, with only a very slight raised area in center of tooth; in the male they are strong, recurved, conical teeth, and the mouth is more arched. Doctor Steindachner does not indicate a spine between dorsals and no patch of spines on posterior lobe of pectoral; in other respects our examples agree with the specimen described and figured by him. Delfin's statement in his description of *R. burgeri* that there are about 52 pectoral rays is undoubtedly a mistake, for if the short anterior rays are counted, there are about 70 rays.

Genus *PSAMMOBATIS* Günther.13. *PSAMMOBATIS BREVICAUDATUS* Cope.

*Psammobatis brevicaudatus* COPE, Proc. Amer. Philos. Soc., 1877, p. 48; Pascasmayo Bay, Peru.—ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 328.

Genus *DISCOPYGE* Tschudi.14. *DISCOPYGE TSCHUDII* Heckel.

*Discopyge tschudii* HECKEL in Tschudi, Fauna Peruana, Pisc., 1845, p. 33, pl. 6; Heradura between Huacho and Chancay.—DUMÉNIL, Ichth., vol. 1, 1865, p. 521.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 8, 1870, p. 454.—STEINDACHNER, Fauna Chilensis, 1898, p. 332, pl. 21, figs. 14a, 14b.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 329.

Genus *PTEROPLATEA* Müller and Henle.15. *PTEROPLATEA CREBRIPUNCTATA* Peters.

## TUYO.

*Pteroplatea crebripunctata* PETERS, Monatsber. Berlin Akad. Wiss., 1869, p. 703; Mazatlan.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 87.—GILBERT and STARKS, Fishes of Panama Bay, Mem. Cal. Acad. Sci., vol. 4, 1904, p. 18.

One specimen, a male, field No. 09507, 35 cm. in length, from Lobos de Afuera.

Disk nearly twice as broad as long; distance from tip of snout to hinder margin of pectorals 1.74 in breadth of disk; snout sharp, rostral angle about 115 degrees; distance from tip of snout to eye 8.60 in breadth of disk; eye small, 4.83 in snout; distance between eyes 1.38 in snout; tip of snout to center of mouth 9.26 in breadth of disk; tip of snout to anterior gill opening 5.53.

Color in life, disk mingled olive green and olive brown, finely marked with darker and lighter and conspicuously speckled with small white spots, these spots smaller than eye, each surrounded by a ring of darker. The spots in this specimen are separated by a distance of one-half inch to 2 inches, generally about 1 inch. Posterior border of disk above of a dark reddish color (specimen out of water some time). Below, the posterior border is of the same color; outer half or more of each wing, rusty orange.

Compared with specimens in the United States National Museum, the disk is dark olive in alcohol instead of a reddish brown.

## Genus MYLIOBATIS Duméril.

## 16. MYLIOBATIS CALIFORNICUS GILL

## RAYO.

- Rhinoptera vespertilio* GIRARD, Proc. Acad. Nat. Sci. Phila., 1856, p. 137; Tomales Bay; not *Myliobatis vespertilio* Bleeker, also a *Myliobatis*.  
*Holorhinus vespertilio* GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 331.  
*Myliobatis californicus* GILL, Ann. Lyc. Nat. Hist., New York, 1865, p. 137, (after Girard).—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 89.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 331.

One specimen, field No. 09120, 58 cm. in length from Callao, and one, field No. 09540, 71.5 cm. in length from Paita, bought from fishermen.

Dimensions of the Paita specimen:

	mm.
Length of disk to front of anus.....	215
Length of disk to posterior edge of pectorals.....	250
Width of disk.....	445
Length of tail.....	465
Snout.....	46
Diameter of eye.....	13
Interorbital (bone).....	41
Tip of snout to middle of nasal flap.....	41
Tip of snout to anterior gill openings.....	83
Distance between anterior gill openings.....	75
Distance between posterior gill openings.....	45
Length of spiracle.....	26
Breadth of distal border of ventrals.....	55
Length of fontanel.....	57
Greatest width (at anterior end).....	25

Disk not quite twice as broad as long, pectorals slightly convex anteriorly and slightly concave posteriorly; distal border of ventrals broad and rounded, much broader than in *M. asperimus*; head broad and depressed, snout rather short, shorter than in *M. asperimus*; lateral teeth in 3 to 5 series, median teeth between 4 and 5 times as broad as long; skin smooth.

Color in alcohol: Dusky brown, a light line originating under middle of spiracle, extending backward along base of pectorals, from this 10 or more transverse lines extending across pectorals, these narrow of bands or lines have well-defined edges but differ so little in coloration from the ground color as to be easily overlooked; ventral surface light.

Genus *CALLORHYNCHUS* Gronow.17. *CALLORHYNCHUS CALLORHYNCHUS* (Linnaeus).

## PEJE-GALLO.

*Chimaera callorhynchus* LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 402.

*Chimaera antarctica* LACÉPÈDE, Hist. Nat. Poiss., vol. 1, 1799, p. 400, pl. 12, fig. 2.

*Callorhynchus antarcticus* GAY, Hist. Chile. Zool., vol. 2, 1848, p. 358.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 8, 1870, p. 351.—STEINDACHNER, Fauna Chilensis, 1898, p. 331.—SMITT, Poiss. Exped. Scient. Terr. Feu, Svenska Exped. Till Magellanslanderna, Havell, vol. 24, No. 5, 1898 (1899), p. 128, pl. 11.

*Callorhynchus callorhynchus* DELFIN, Cat. Peces de Chile, 1901, p. 27.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, p. 764; Callao, Peru.

One specimen, field No. 09105, 61 cm. in length, from La Ventanilla, between Ancon and Callao, taken with a gillnet, fishing in the surf.

Following are the dimensions of this individual:

	mm.
Total length, including cartilaginous appendage.....	610
Total length, not including appendage.....	590
Length (exclusive of appendage) to origin of lower caudal lobe.....	410
Length of head (exclusive of appendage).....	100
Diameter of eye.....	17
Interorbital.....	38
Width of head.....	55
Tip of snout to origin of first dorsal.....	125
Tip of snout to origin of second dorsal.....	293
Distance from origin of first dorsal to origin of second dorsal.....	157
Length of base of first dorsal.....	61
Length of base of second dorsal.....	103
Length of base of anal.....	81
Length of first dorsal spine.....	129
Length of anterior border of second dorsal.....	68
Length of anterior border of anal.....	62
Length of pectorals.....	154
Length of ventrals.....	74
Depth of body.....	97
Length of caudal.....	176

Body compressed, caudal peduncle slender; head rather stout; dorsal spine long, with serrate edges; second dorsal elevated anteriorly; caudal ending in a long filament; anal long, pointed, inserted close to caudal; ventrals large; pectorals very large and broad, tips reaching vent.

Body silvery, with large round black spots; a V-shaped black area between eyes; a second in front of first dorsal; a black spot below first dorsal; space between dorsals crossed by three black saddles, interrupted by median line of back; 2 black areas below second

dorsal; dorsal surface of caudal peduncle black; a row of about 6 black spots along lateral line; a second row below lateral line; a black area above base of ventrals; vertical fins dusky, darkest at tips; paired fins blackish.

### Family CLUPEIDAE.

#### THE HERRINGS.

##### KEY TO GENERA REPRESENTED.

- a.<sup>1</sup> Vertebrae about 50 in number (46 to 56); species of northern or southern regions.
  - b.<sup>1</sup> Vomer with teeth; ventral scutes weak, ventrals below middle of dorsal; vertebrae 50 to 56; skeleton rather firm.
    - c.<sup>1</sup> Origin of dorsal well in advance of the middle of body. *Potamalosa*, p. 19.
  - b.<sup>2</sup> Vomer without teeth; ventral scutes very weak, the belly more or less rounded; vertebrae about 52; ventrals under middle of dorsal. Skeleton weak; flesh oily.-----*Sardinella*, p. 20.
- a.<sup>2</sup> Vertebrae about 42 (40 to 44); tropical species with the scales large and usually firmly attached; ventrals inserted under middle of dorsal; adipose eyelid present.-----*Hurengula*, p. 21.

### Genus POTAMALOSA Ogilby.

#### 18. POTAMALOSA NOTACANTHOIDES (Steindachner).

##### MACHETE.

*Clupea (Alosa) notacanthoides* STEINDACHNER, Ichth. Notizen, No. 9, 1869, p. 20, pl. 7; Mazatlan.

*Potamalosa notacanthoides* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 333.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 35, 1906, p. 778.

*Clupea notachanthus* GÜNTHER, Cat. Fish. Brit. Mus., vol. 7, 1868, p. 443.—DELFIN, Cat. Peces de Chile, 1901, p. 39.

Five specimens, field No. 447, 12.6 to 14.3 cm. in length, and two specimens, field No. 263, 22.1 and 25.5 cm. in length, all from Callao.

Head 2.94 to 2.97 in length; depth 2.85 to 3.07; eye 4.12 to 4.85 in head; snout 4.85 to 5.07; maxillary 2.05 to 2.26; interorbital 4.46 to 4.85; pectoral 1.47 to 1.74; ventrals 2.35 to 2.76; dorsal scutes 23 to 25; ventral scutes 35 to 36; D. 20 or 21; A. 14-17.

In these specimens there are 13 or 14 divided rays in the anal, but in the smaller individuals a larger number of simple rays is discernible in front of the divided rays than in larger examples.

Body deep, compressed, curvature of ventral outline greater than that of the dorsal; head short, compressed; mouth large, oblique, jaws subequal; maxillary extending slightly beyond vertical from posterior border of eye; snout short, blunt.

Distal margin of dorsal concave, anterior rays longest, origin of dorsal in advance of middle of body; caudal forked nearly to base;

anal low, distal margin truncate, anterior rays longest; ventrals short, tips reaching over half distance from base to vent; tips of pectorals extending to within two-thirds diameter of eye to base of ventrals; scales striate and fimbriate; scutes on abdomen distinct, those in front of dorsal, weak; venules on cheek, opercle, and shoulder very distinct; opercle translucent.

Color in alcohol: Small examples blackish on back, silvery on sides and belly; scales everywhere glassy; a row of 4 to 11 small oblong black areas from upper edge of opercle along the side to below posterior base of dorsal; opercle dusky; caudal light with dusky marking; anal light, anterior rays tipped with dusky; pectorals and ventrals light.

In the larger individuals the sides below blackish, back yellowish, becoming silvery on the elongate scales above scutes of belly; row of black spots from opercle in lower part of dusky area scarcely discernible. In the largest individual there is a row of 8 black spots nearly as large as pupil from center of opercle along side to behind dorsal, below this row 3 other spots anteriorly; in the other example, these are very irregular in their arrangement; inner dark border to caudal lobes very distinct.

### Genus *SARDINELLA* Cuvier and Valenciennes.

#### 19. *SARDINELLA SAGAX* (Jenyns).

##### *SARDINA*.

- Clupea sagax* JENYNS, Zool. Voy. *Beagle*, Fishes, 1842, p. 134; Lima; San Lorenzo Islands.—STEINDACHNER, Fauna Chilensis, 1898, p. 331.—DELFIN, Cat. Peces de Chile, 1901, p. 39.
- Alausa fimbriata* KNER and STEINDACHNER, Neue Fische, Mus. Godeff, Sitz. Akad. Wiss. Wien, 1866, p. 31 (386), fig. 15; Valparaiso.
- Clupanodon fimbriata* ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 332.
- Clupanodon fimbriatus* ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 334.
- Clupanodon sagax* ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 334.
- Sardinella sagax* JORDAN, Guide to Study Fishes, vol. 2, 1905, p. 50, name only.
- Sardinella fimbriata* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 778.

One specimen, field No. 446, 21 cm. in length, and two specimens, field No. 452, 17 and 19.6 cm. in length, from Callao; and 21 specimens, field No. 09448 (part), 2.8 to 5.3 cm. in length from Lobos de Afuera.

Head 3.27 in length; depth 4.35; eye 4 in head; snout 3.46; maxillary 2.36; pectoral 1.57; D. 18; A. 18.

Body elongate, subcylindrical; head elongate, compressed; snout short, rather blunt; eye large, adipose eyelid well developed; jaws subequal; mouth small, horizontal; maxillary reaching vertical from middle of eye; no teeth on jaws; gillrakers numerous, very slender and long, longer than eye, 3.5 in head, angle sharp; veining on cheeks and opercles very distinct, these extending backward onto shoulders.

Scales thin, deciduous, very weakly ctenoid; median line of belly armed with scutes, 20 anterior to ventrals, 15 between ventrals and anus; origin of dorsal two-thirds diameter of eye nearer tip of snout than base of caudal; dorsal triangular, middle rays shorter; caudal deeply forked; anal low; ventrals short, 3 in head, origin of ventrals slightly posterior to middle of dorsal; tip of pectoral extending to within one diameter of eye from origin of ventral.

Color, lustrous blue on back, becoming silvery yellow on belly; fins dusky.

Coast of Peru and Chile, New South Wales.

In Sherrin's Handbook of the Fishes of New Zealand (page 72, 1886) we find the following note on this species:

This ——— herring ——— visits the east coast of Otago every year in February and March, and when the schools migrate, they extend as far as the eye can reach, followed by a multitude of gulls, mutton-birds, baracuda and porpoises. So densely packed are they some years that by dipping a pitcher in the sea, it would contain half fish, so that if large boats and suitable nets were employed thousands of tons could be caught.

#### Genus HARENGULA Cuvier and Valenciennes.

##### 29. HARENGULA STOLIFERA (Jordan and Gilbert).

##### PELADA.

*Clupea stollifera* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 4, 1881, p. 339; Mazatlan, Mexico.

*Sardinella stollifera* JORDAN, Fishes of Sinaloa, Reprint, Proc. California Acad. Sci., ser. 2, vol. 5, 1895, p. 408, pl. 28.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 431; vol. 4, 1898, pl. 73, fig. 194.—BOULENGER, Bull. Mus. Zool. Anat. Comp., Torino, vol. 14, 1899, p. 1.—GILBERT and STARKS, Fishes of Panama Bay, Mem. Cal. Acad. Sci., vol. 4, 1904, p. 39.

Two specimens, field No. 1030, 14 and 14.3 cm. long, from Capon.

Head 4.32 in length; depth 3.4; eye 2.9 to 3.1 in head; snout 3.66; maxillary 2.4; interorbital 4; P. 1.2; V. 1.85; D. 15-16; A. 19-22; scales 40-11; scutes 17+12=29. Body deep and strongly compressed, the ventral outline more strongly arched than the dorsal; greatest depth of body in front of dorsal; head short; lower jaw projecting, upper slightly emarginate; mouth small, oblique; no teeth on vomer or palatines, small patch on tongue; a few small weak teeth on each jaw; eye large, longer than snout, adipose eyelid well

40656°—Bull. 95-17—3

developed; origin of dorsal slightly in advance of ventrals, nearer tip of snout than base of caudal by about two-thirds length of head; scales smooth, firm, their edges with weak serrations—these serrations inconspicuous in the young from the Bay of Concepcion, Lower California; dorsal, anal, and caudal, each with a narrow sheath of scales; ventral scutes well developed.

Ground color in spirits, greenish, scales dusky edged; trace of a dark median line on back; a broad well-defined silver band alongside on level of eye extending from opercle to base of caudal, margined above with blue, narrowing on caudal peduncle and suddenly widening at base of caudal; belly with a yellowish wash; fins yellowish; caudal lobes tipped with black.

Jordan and Herre in a Review of the Herring-like Fishes of Japan,<sup>1</sup> states as a character of the genus *Harengula* "adipose eyelid obsolete" and include in the synonymy of this genus *Lile* Jordan and Evermann<sup>2</sup> (*stolifera*). Our specimens and others from Concepcion Bay, Lower California, in the Reserve Series of the Bureau of Fisheries, identified as this species, have an adipose eyelid. It is translucent and lying against the silvery iris might easily be overlooked. The adipose eyelid is also present in specimens of *H. moluccensis* from Bulan, Philippine Islands. This genus is very close to *Sardinella*, differing mainly in having fewer vertebrae.

The number of dorsal and anal rays in this species is subject to considerable variability.

## Family ENGRAULIDAE.

### THE ANCHOVIES.

#### KEY TO GENERA REPRESENTED.

$\alpha^1$ . Vertebrae about 41 in number; bones firm; species chiefly tropical.

*Stolephorus*, p. 22.

$\alpha^2$ . Vertebrae about 45; bones feeble; species of the temperate zones.

*Engraulis*, p. 23.

### Genus STOLEPHORUS Lacépède.

#### KEY TO PERUVIAN SPECIES.

$\alpha^1$ . D. 14; A. 23 or 24; depth of head at occiput equal to length of head.

*tapirulus*, p. 23.

$\alpha^2$ . D. 16 or 17; A. 26 or 27; depth of head at occiput 2 in length of head.

*peruanus*, p. 23.

<sup>1</sup> Proc. U. S. Nat. Mus., vol. 31, 1907, p. 633.

<sup>2</sup> Fish. North and Mid. Amer., vol. 1, 1896, p. 431.

21. *STOLEPHORUS TAPIRULUS* (Cope).

*Engraulis tapirulus* COPE, Proc. Amer. Philos. Soc., 1877, p. 45 (p. 29, separate); Pacasmayo Bay.

*Stolephorus tapirulus* ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 335.

22. *STOLEPHORUS PERUANUS* (Steindachner).

*Engraulis peruanus* STEINDACHNER, Ichth. Beitr., 1879, vol. 8, p. 60; Callao.

*Stolephorus peruanus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 335.

Genus *ENGRAULIS* Cuvier.

## KEY TO SPECIES REPRESENTED.

$a^1$ . Depth 5.8 to 6.5 in total length; eye 4.15 to 4.5 in head; snout 6.27 to 7.2-----*ringens*, p. 23.

$a^2$ . Depth 5.25 in total length; eye 4 in head; snout 4 (in drawing).  
*nasus*, p. 24.

23. *ENGRAULIS RINGENS* Jenyns.*ANCHOBETA*.

Plate 3, fig. 1.

*Engraulis ringens*, JENYNS, Zool. Voy. *Beagle*, 1842, p. 136; Callao.—STEINDACHNER, Ichth. Beiträge, 1879, p. 62.—GÜNTHER, Cat. Fish. Brit. Mus., 1868, p. 336.—STEINDACHNER, Fauna Chilensis, 1898, p. 331.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 336.

Six specimens, field No. 09163, 13.6 to 14 cm. in length, from Chimbote; four, field No. 09528, 11.6 to 13.8 cm. in length, from Lobos de Tierra; and 38, field No. 298, 3.6 to 4.8 cm. in length, from between Lobos de Tierra and Eten.

Doctor Coker states that between Lobos de Tierra and Eten he passed through many schools of "anchobeta." Among them small red spots in the water were conspicuous. These spots consisted of very small anchobetas.

Head 3.1 to 3.25 in length; depth 4.75 to 5.25; eye 4.15 to 4.5 in head; snout 6.27 to 7.2; maxillary 1.52 to 1.57; interorbital 5.8 to 6; pectoral 1.77 to 2; ventrals 2.88 to 3.25; D. i, 14 or 15; A. 19 or 20.

Body rounded above, slightly carinated below; snout short, pointed, strongly projecting beyond jaws; eyes large; teeth small; anterior rays of dorsal longest, 2 in head; insertion of dorsal nearer base of caudal by a distance varying from 0.75 to 1 diameter of eye; caudal forked; anterior anal rays longest, distal margin slightly concave; pectorals and ventrals short; scales large, deciduous; some individuals when dry show marked venules on opercle.

Color in alcohol, back bluish; sides silvery; traces of lateral band in some specimens.

24. *ENGRAULIS NASUS* Kner and Steindachner.

*Engraulis nasus* KNER and STEINDACHNER, Neue Fische Mus. Godeffroy, 1866, p. 388 (33), fig. 17; Chincha Islands, Peru.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 335.

The validity of this species is questionable. From the description it appears that the depth is somewhat greater, the eye larger, and the snout and maxillary longer, than in *E. ringens*.

Family LEPTOCEPHALIDAE.

THE CONGER EELS.

Genus LEPTOCEPHALUS (Gronow) Scopoli.

The following two species have been described from Peruvian waters:

25. *LEPTOCEPHALUS MULTIMACULATUS* Steindachner.

*Leptocephalus multimaculatus* STEINDACHNER, Ichth. Notizen, No. 9, 1869, p. 27; Peru.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 332.

26. *LEPTOCEPHALUS PERUANUS* Steindachner.

*Leptocephalus peruanus* STEINDACHNER, Ichth. Notizen, 1869, p. 28; Coast of Peru.—ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 332.

Genus OPHICHTHUS Thunberg and Ahl.

KEY TO SPECIES REPRESENTED.

a.<sup>1</sup> Maxillary and mandibular teeth biserial in the adult.

b.<sup>1</sup> Gape of mouth about 2.5 in length of head; color olivaceous with large dark spots.....*grandimaculatus*, p. 24.

b.<sup>2</sup> Gape of mouth about 2.5 in length of head; color uniform brown, clear on belly.....*odlaensis*, p. 25.

a.<sup>2</sup> Maxillary and mandibular teeth tri or quadriserial.

Color dark brown above, yellowish olive below; a row of small white spots along lateral line anteriorly, similar spots on nape.

*pacifici*, p. 25.

27. *OPHICHTHUS GRANDIMACULATUS* (Kner and Steindachner).

ANGUILLA.

*Ophichthys grandimaculatus* KNER and STEINDACHNER, Neue Fische Mus. Godeffroy, Sitz. Akad. Wiss. Wien, vol. 20, 1866, p. 389, pl. 5. fig. 13; Coast of Peru.

*Ophichthys grandimaculatus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 332.

One specimen, field No. 09531, 38 cm. long, from Lobos de Tierra.

Trunk shorter than tail, 1.37 in length of latter; head 4 in trunk; eye 6.66 in head, shorter than snout which is 5.7 in head; gape of

mouth 1.6; P. 2.5; maxillary teeth pointed, biserial, recurved, fixed; vomerine teeth uniserial, the three anterior teeth stronger than the others.

Color in life, olivaceous with large dark spots; the spots on head small (about the size of eye or smaller) and set closely. In spirits, the ground color is a very light brown; a row of black spots along median line of back; some of these circular, crossing dorsal fin, equal on each side of median line; others hemispherical and appear only on one side of median line; others appear as if the two hemispheres of a circle had been partially crowded by one another until they fail to match, the amount of variation being very great; below these and alternating with them is a row of larger black circles, each of these tending to pair with its fellow on the opposite side and extending below lateral line, in some cases appearing like a broad vertical crossband on back; slightly below the plane of this series and alternating with the spots composing it is a third series, smaller than the second and similar in position to the first, not continuing beyond anterior half of tail but replaced on posterior half of tail by a series of spots on the ventral surface, crossing the anal, similar to the first row on median line of back; head dotted with small black circular areas, smaller than those on body; interspaces on dorsal between black areas, body color; anal blackish; pectoral body color with three blackish areas.

#### 28. *OPHICHTHUS CALLAENSIS* (Günther).

*Ophichthys callaensis* GÜNTHER, Zweiter Ichth. Beitr. Exempl. Mus. Godeffroy, Heft 4, 1873, p. 92; Callao.

*Ophichthys callaensis* JORDAN and DAVIS, Apodal Fishes Amer. and Europe, Rep. U. S. Fish Com., 1888 (1892), p. 633.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 332.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 778.

#### 29. *OPHICHTHUS PACIFICI* (Günther).

##### ANGUILLA.

Plate 3, fig. 2.

*Ophichthys pacifici* GÜNTHER, Cat. Biol. Brit. Mus., vol. 8, 1870, p. 76; Chile and Peru.

*Ophichthys uniserialis* COPE, Proc. Amer. Philos. Soc., 1877, p. 47; Pacasmayo.

*Ophichthys pacifici* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 332.

*Ophichthys uniserialis* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 332.

One specimen, field No. 09556, 68 cm. in length, from Paíta, and one, field No. 09670, 28.6 cm. in length, from Callao.

Head 2.84 in body (measured from tip of snout to center of vent); depth 7.78; eye 1.8 in snout, 10.4 in head; snout 5.78 in head; gape

of jaws measured from tip of snout 2.5; space between eyes 1.5 times diameter of eye; body from tip of snout to center of vent 1.3 in tail; trunk 2.02 in tail; pectoral nearly as long as gape of jaws, 2.54 in head; tip of snout to insertion of dorsal 2.22 in body.

Teeth in lower jaw in two distinct series, sharp, pointed, fixed, inside of these an inner series of irregular small teeth not discernible without dissection except for one or two more strongly developed teeth; teeth in the upper jaw in two series; premaxillary and vomerine teeth in a single series, those on premaxillaries longest and sharply pointed.

Color in alcohol, dark brown above, below yellowish olive, the line of separation of the two colors quite distinct; a row of about 20 small round white spots, about one-fourth diameter of eye, arranged along lateral line, disappearing posteriorly; a number of similar spots on nape. Description of specimen 68 cm. in length from Païta.

In a small individual from Callao the head is 2.7 in body; body (including head) 1.46 in tail; trunk 2.33 in tail; eye 1.42 in snout, 8.96 in head; snout 6.32 in head; gape of jaws 3; pectoral 2.4; distance from tip of snout to insertion of dorsal 1.76 in body. Teeth in jaws biserial, those on premaxillary and vomer uniserial. Color in alcohol essentially as in the larger example; on the top of the head back of the eyes there is a trace of a narrow white line extending across top of head, zigzagging downward to level of gape of jaw.

These specimens agree as closely with Cope's description of *O. uniserialis* as with Günther's description of *O. pacifici*, and the two species appear to be one. In Günther's description of *pacifici*, he states the teeth on maxillary and mandible are triserial or quadriserial. In our larger example there are two rows of well-developed teeth in each jaw, with several straggling teeth of a third row in the lower jaw; appearing above the mucus and integument, dissection reveals an inner bony ridge from which the third row is developed, with small teeth on it; in the upper jaw there is a trace of a similar ridge.

#### Genus GYMNOTHORAX Bloch and Schneider.

##### 30. GYMNOTHORAX WIENERI Sauvage.

##### MORENA; MORENA COLORADO.

Plate 3, fig. 3.

*Gymnothorax wieneri* SAUVAGE, Bull. Soc. Philom. Paris, 1883, p. 161. July 7; Chile or Peru.

*Lycodontis wieneri* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1890, p. 332.

Two specimens, field Nos. 09677 and 09471, respectively 40 and 81 cm. long, from Lobos de Afuera, and one, field No. 449, 64 cm. long, from Callao.

Head 3.36 to 4.3 in trunk; snout 4.32 to 5.1 in head; eye 3 to 3.57 in snout, 15.3 to 15.8 in head; gape of mouth 2.03 to 2.55 in head; branchial aperture greater than diameter of eye; nasal tube about two-thirds eye in height; tail equaling length of body; snout blunt; eye situated above center of gape of mouth; a row of well-developed, recurved, subequal, compressed teeth on jaws, about 40 on upper and 50 on lower; outside these there is a supplementary row (easily overlooked) close to base and usually opposite interspaces between larger teeth, these best developed on front of jaw; 3 longer, fanglike teeth on palatines, posterior to eye; 3 or 4 recurved fanglike teeth on front of vomer, followed by an interspace, then a row of 12 or more small subequal teeth; in our largest specimen the anterior teeth in this row are somewhat irregularly placed, tending to form two rows.

Color in alcohol, chocolate-brown, marbled with darker and lighter; belly lighter, marblings not so distinct. Color-pattern difficult to describe because of its great irregularity.

Color in life: Entire body and head, dirty brown, mottled.

These specimens agree in all essential characters with the description by Sauvage.

### Family CHARACINIDAE.

#### THE CHARACINS.

##### KEY TO GENERA REPRESENTED.

- a*<sup>1</sup>. Adipose fin present.  
*b*<sup>1</sup>. Maxillary completely toothed; intermaxillary with three series of notched or tricuspid teeth; nostrils close together; gill-membranes free from isthmus.....*Brycon*, p. 27.  
*b*<sup>2</sup>. Maxillary not completely toothed.....*Astyanax*, p. 27.  
*a*<sup>2</sup>. No adipose fin; maxillary without teeth.....*Lebiasina*, p. 29.

#### Genus BRYCON Müller and Troschel.

##### 31. BRYCON ATRICAUDATUS (Kner).

*Chalceus atricaudatus* KNER, Sitzgsber Akad. Wiss. München, 1863, p. 227.  
*Brycon atricaudatus* GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 336.—  
 STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 777; Palta and Eten, Peru.—EIGENMANN, Cat. Fresh-water Fish. Trop. and South Temp. America, 1910, p. 431.

#### Genus ASTYANAX Baird and Gerard.

##### 32. ASTYANAX PERUANUS (Müller and Troschel).

#### ANCHO.

*Tetragonopterus peruanus* MÜLLER and TROSCHER, Hor. Ichth., vol. 1, 1845, p. 28, pl. 8, fig. 1; Peru.—CUVIER and VALENCIENNES, His. Nat. Poiss., vol. 22, 1849, p. 115 (153).—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 775.

*Tetragonopterus scabripinnis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 22, 1849, p. 114; Rio Rimac, Lima.

*Tetragonopterus peruvianus* GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 327.—STEINDACHNER, Herpet.-Ichthyol. Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 55.

*Tetragonopterus microphthalmus* GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 324; Peru and Guatemala; part.

*Astyanax peruanus* EIGENMANN, The Fresh-water Fish. Patagonia and an Exam. Archiplata-Archhelenis Theory, 1909, p. 266; name only.

Eight specimens, field No. 09425, 5.3 to 7 cm. in length, from Pacasmayo; fifteen, field No. 270, 2.2 to 6.9 cm. in length; two, field No. 269, 9.2, and 9.9 cm. in length; and one, field No. 262, 7.2 cm. in length, from Rimac River below Lima; four specimens, field No. 275, 9 to 9.8 cm. in length, from Lima market.

Head 3.6 to 4 in length; depth 2.5 to 3; eye 3.4 to 4 in head; snout 3.75 to 4; interocular 2.63 to 2.8; pectorals 1.2 to 1.25; ventrals 1.6 to 1.8; D. I, 9 or 10; A. II, 25 or 26; scales 6 or 7-35-6.

Body rather robust; ventral outline more deeply curved than dorsal outline; snout blunt, nape straight or slightly concave; maxillary reaching to vertical from about front of pupil; eye large; gill-rakers short and rather slender, 7+11.

Origin of dorsal midway between tip of snout and base of caudal; height of dorsal 1.4 to 1.55 in head; caudal forked; origin of anal under posterior third of dorsal, its anterior rays longest, distal margin concave; pectorals and ventrals vary greatly and the distance between their insertion is variable, varying from 0.76 to 1.14 in head. Description based on specimens from the Rimac River below Lima and from the Lima market, 8.9 to 9.8 cm. in length.

Color in life of field No. 262 from the Rimac River, olivaceous above; silvery on sides and below; iridescent; a greenish silvery lateral band distinguishable posteriorly; anal and sides of belly (laterally) punctate with red; sides of body with olive; median basal part of caudal black; pectoral tinged reddish orange; a large violet spot on opercle; iris dusky with orange in antero-dorsal part.

Among the larger specimens were ripe females and males. The anal rays in the males are well armed with rows of small sharp spinules, giving them a somewhat thickened appearance; occasional spinules are found near the tips of the longer rays in the females. These specimens in the spawning condition were taken about November 6, 1907.

Specimens from Pacasmayo taken March 12, 1907, also have these spinules. These specimens were not in spawning condition.

In the Pacasmayo specimens the tips of the pectorals reach to the insertion of the ventrals, and in nearly all of these the ventrals reach to the origin of the anal. The average in individuals from the Rimac is slightly less.

Color in life of specimens from Pacasmayo, olivaceous silvery; ventrally in posterior half of body, light purplish; bright spot of same color on opercle just below level of lateral line, and of the size of the pupil; light greenish silvery band on side, almost disappearing under anterior dorsal; but the dorsal limit of the band may be traced forward, and in the extended path of the stripe anteriorly are two or more spots of the same color, the most anterior of which is just behind opercle; glassy gold spot back of and above eye; the gold not superficial but seen through transparent glassy tissue; scales below lateral line and, to some extent, those above, with minute olive spots or specks; sides of head with similar specks; on lower part of sides these specks are red; similar minute red and olive spots on anal and to some extent on caudal; fins more or less tinged with yellow; caudal blackish at base of fork, a green spot on sides just anterior to this.

Genus **LEBIASINA** Cuvier and Valenciennes.

33. **LEBIASINA BIMACULATA** Cuvier and Valenciennes.

**CHORO-COQUE; LAS PENITAS.**

*Lebiasina bimaculata* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 19, 1846, p. 382, pl. 587.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 286.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 772; Callao and Eten, Peru, and Santa Rosa, Ecuador.

Seven specimens, field No. 267, 7.8 to 13.9 cm. in length, and five specimens, No. 270, 5.2 to 7 cm. in length, from the Rimac River below Lima.

Four specimens, field, No. 457, 10.7 to 12.7 cm. in length, from Lima market; two, field No. 09430, 5.8 and 7 cm. in length, from Pacasmayo; and three, field No. 322, 9.3 to 10.3 cm. in length, from a "pozo" a little short of half-way between Amotape and Tumbes.

Head 3.42 to 3.88 in length; depth 3.35 to 3.6; eye 5 to 6.4 in head; snout 4 to 4.15; interorbital 3 to 3.22; D. 9 or 10; A. 11 or 12; scales 25 or 26.

Body robust, head short, evenly rounded; teeth tricuspid; fins evenly rounded, longest dorsal ray 1.68 to 2 in head; base of dorsal 3 to 3.27; longest anal ray 1.85 to 1.92; base of anal 2.1 to 2.4; pectoral 1.38 to 1.45; ventral 1.68 to 1.71; origin of dorsal slightly behind origin of ventrals.

Color in alcohol of Lima market specimens, back plumbeous, sides tinged with yellow, ventral surface yellow; scales on sides of body with yellow centers and dusky edges, these forming horizontal rows; a round black spot at base of caudal; a very indistinct trace of a black lateral band and a dark spot behind opercle. In the indi-

viduals from the Rimac River, three rows of golden spots, one on each scale, along the rows of scales, and in the smaller individuals the plumbeous lateral band is distinct.

Color in life of Pacasmayo specimens, olivaceous, white below; four rows of the large scales are marked with bright orange spots. (These are the third, fourth, fifth, and sixth longitudinal rows, counting from the back.) Pectoral, ventral, and anal tinted with reddish orange; caudal margined posteriorly with reddish; at middle of base of caudal is a spot of very dark green, almost black.

In the three specimens taken from a "pozo" between Amotape and Tumbes, the scales are lost, the fins broken and the body appears much shrunken, giving these individuals quite a different appearance. The black caudal spot is quite distinct and the fin counts are the same.

The "pozo," where these fish occurred in abundance, is a small spring, the outlet of which flows but a short distance before it dries up and disappears. It corresponds closely to the "cenote" of Mexico.

## Family SILURIDAE.

### THE CATFISHES.

#### KEY TO GENERA.

- $\alpha^1$ . Nostrils close together, neither with a barbel, the posterior with a valve; teeth on the palate; caudal forked. (Species chiefly marine.) Lower jaw with 4 barbels; palatine teeth fixed; both jaws with teeth. Gillrakers few, 5 to 25; eyes above level of mouth.....  
*Galeichthys* (p. 30), including *Tachysurus*, p. 32.
- $\alpha^2$ . Nostrils remote from each other. (Freshwater species.) Posterior nostril without barbel; barbels, 6; adipose fin well developed; teeth in villiform bands. Teeth on vomer none, or in small patches. Head covered with soft skin above, not granulated. Snout broad, scarcely produced; barbels terete or slightly flattened, not margined; head longer than broad.
- $\beta^1$ . Occipital process, if present, not reaching the dorsal plate; dorsal spine pungent.....*Rhamdia*, p. 33.
- $\beta^2$ . Occipital process narrow, reaching the dorsal plate; fontanel reaching base of occipital process, a bridge across it above posterior margin of eye; humeral process spine-like.....*Pimelodella*, p. 33.

### Genus GALEICHTHYS Cuvier and Valenciennes.

#### KEY TO SPECIES.

- $\alpha^1$ . Head and occiput entirely covered by flesh and skin; occipital process sparingly granulated.....*peruvianus*, p. 31.
- $\alpha^2$ . Occipital process and bones of head exposed or covered with very thin skin; bones on top of head and occipital process granular; palatine teeth in large ovate patches.....*simonsi*, p. 31.

34. *GALEICHTHYS PERUVIANUS* Lütken.

## BAGRE.

Plate 4, fig. 1.

*Galeichthys peruvianus* LÜTTKEN, Ichth. Vidensk. Meddel., 1874, p. 205; Callao.—STEINDACHNER, Ichth. Beitr., vol. 4, (LXXII), 1875, p. 34.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 122.

*Tachisurus peruvianus* EIGENMANN and EIGENMANN, Nematognathi, 1890, p. 51.

Two specimens, field Nos. 09116 and 09118, respectively 37.5 and 36 cm. in length, from La Ventanilla, between Ancon and Callao, obtained while fishing in the surf with a gillnet.

Head 3.28 in length; depth about 5; eye 7 in head, 4 in interocular; snout 3.1 to 3.2; width of head 1.45; D. I., 7; A. 14.

Body elongate, tapering, caudal peduncle slender, its least depth 4 in head; head rounded, not much depressed; interorbital rounded; snout broad, rather bluntly rounded; top of head smooth, with traces of a few small granulations; fontanel rather deep, barely reaching anteriorly to above posterior margin of eye; top and sides of head with traces of reticulating mucous canals; maxillary barbel not reaching to base of pectoral; mental barbels not reaching gill-opening; post-mental barbels reaching to or beyond gill-opening (barbels quite variable in length). A broad band of villiform teeth on maxillaries; two small patches of villiform teeth on vomer; patches on palatines wider anteriorly, tapering to a point posteriorly; distance from insertion of dorsal to tip of snout 2.66 in length; serrations on front of dorsal spine weak, the spine 1.8 in head; distance from insertion of dorsal to adipose fin 2.75 in length; caudal deeply forked; ventrals small, 2.04 in head; pectorals 1.55.

Color in alcohol, back and sides bluish black; lower parts white; a rufous band as wide as eye along the lateral line; fins blackish.

35. *GALEICHTHYS SIMONSI* Starks.

## BAGRE.

*Galeichthys simonsi* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol 30, 1906, p. 764, figs. 1-2; Callao.

One specimen, field No. 1011, 31.5 cm. in length, from Tumbes, and seven small specimens, field No. 1032, 5.5 to 7 cm. in length, from Capon. These were observed in large numbers near the beach at Coleta Noel (Capon).

These specimens seem to belong to this species, although the differences separating them from *G. jordani* appear to be very slight.

Head 3.31 in length; depth 4.75; eye 6.15 in head, 2.3 in snout, 3 in interorbital; snout 2.66 in head; width between angles of

mouth 2.35; width of head 1.33; depth of head 1.73; D., 1.6; A., 18, including rudiments. Upper profile of head nearly straight; interorbital broad and flat; snout blunt, rather truncate; granular area on top of head similar in outline to that in *G. jordani*, the diverging points extending anteriorly to above anterior margin of pupil; fontanel groove reaching nearly to occipital process, slightly narrower in its posterior half than anteriorly, in this respect differing from the type; slightly constricted at the center where it enters the granular area; palatine teeth in large ovate patches; the vomerine patches meeting at the median line; maxillary barbel reaching base of pectoral, the postmental barbels to edges of gill opening and ventral barbels about three-fifths of distance from their base to gill opening; humeral spine concave on its upper surface, sharp pointed. (Dorsal and pectoral spine broken); longest dorsal rays 1.6 in head; base of adipose dorsal 4; caudal deeply forked; anterior anal rays longest, 2.16; middle rays of ventral longest, 1.6, upper surface of inner rays provided with a much thicker fold of integument, tips of ventrals reaching past insertion of anal; pectoral as long as ventrals.

Color of back and sides above lateral line, bluish black; lower parts silvery white; top of head similar in color to body; on sides below eye, this color abruptly white, the line of demarcation less distinct on opercles; a large black spot behind gill opening covering humeral spine; base of dorsal spine black, rest of fin pale; adipose fin light distally; anal dark, margined with lighter, a small dark area at base of ventrals.

#### Genus TACHYSURUS Lacépède.

##### 34. TACHYSURUS EQUATORIALIS Starks.

##### BAGRE.

*Tachysurus equatorialis* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 766, figs. 3 and 4; Guayaquil, Ecuador.

Two specimens, field No. 09568, 17 and 18.6 cm. in length, from Paíta.

Head 3.85 in length; depth 5.7; eye 5 in head; snout 2.66; width between angles of mouth 2.66; interorbital 2.11; longest dorsal ray 1.29; longest anal ray 2.25; pectoral 1.54; ventral 1.6; caudal lobe 1; depth of caudal peduncle 3.1; D. I, 6; A., 23.

Upper anterior profile appearing perfectly straight and rather steeply sloping from dorsal spine nearly to tip of snout, where it curves very slightly downward; head as viewed from side, sharply wedge-shaped; top of head very finely granular, the granulated area ending some distance behind eyes, but continued forward to a point on each side, as a slightly rugose surface covered by thin skin, to

opposite posterior margin of the eye. The fontanelle groove fails to reach the occipital process by a distance equal to vertical diameter of eye, its widest and deepest part where it transverses the granulated area on top of head, where for a distance equal to the long diameter of eye it is sharply defined, and as wide and deep as base of slender maxillary barbel; posteriorly it ends in a point; anteriorly it is continued as a faint line with indefinite gently rounded edges to in front of the eyes, where it abruptly becomes wider, deeper, and sharply defined for a short distance and ends opposite the posterior nostril. (Starks.)

Dorsal high; caudal deeply forked; anterior anal rays longest; distal margin slightly concave; ventrals small; pectorals rather elongate, tips reaching nearly to vertical from posterior base of dorsal.

Color in alcohol: Dorsal surface bluish black with a tinge of brown on sides; ventral surface whitish, the region below lateral line dotted with brown; fins dusky; barbels bluish black.

These specimens agree closely with Starks's original description of the type.

#### Genus RHAMDIA Bleeker.

##### 37. RHAMDIA GILLI Starks.

*Rhamdia gilli* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 769, pl. 65, fig. 1; Rio Eten, Eten, Peru.

The type and one cotype were taken at Eten, Peru, in the Rio Eten.

#### Genus PIMELODELLA Eigenmann and Eigenmann.

##### 38. PIMELODELLA YUNCENSIS Steindachner.

*Pimelodella yuncensis* STEINDACHNER, Herpet-ichthyol, Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 47; Pacasmayo, Peru.

#### Genus PYGIDIUM Meyen.

##### KEY TO PERUVIAN SPECIES.

- a<sup>1</sup>. Dorsal placed partly over the anal; caudal truncate or rounded.
- b<sup>1</sup>. First ray of the pectoral prolonged except in very young.
- c<sup>1</sup>. Teeth in broad bands in both jaws.
  - d<sup>1</sup>. Head 6.5 to 7 in total length; coarse brown confluent blotches, few above anteriorly; forming two series posteriorly with pale band between.....*poeyanum*, p. 34.
  - d<sup>2</sup>. Head about 5 in length (5.33 to 6.6 in total); ground color reddish brown with lighter spots and vermiculations.....*trivulatum*, p. 34.
- e<sup>1</sup>. Teeth in two series in each jaw (?).
- e<sup>2</sup>. Head narrowed forward, heart-shaped, scarcely wider than long; upper maxillary barbels reaching to base of pectoral; origin of anal below end of dorsal; a dark lateral band, two series of spots above it; top of head spotted. Head 7; D. 8; A. 6. (Kner and Steindachner.).....*tacnia*, p. 35.

- c*<sup>1</sup>. Head of uniform width; width of mouth more than half length of head. Teeth in the anterior series of each jaw compressed. Maxillary barbels reaching beyond base of pectoral. Head and body with numerous dark spots. Head 7; D. 9; A. 7. (Kner and Steindachner.)-----*laticeps*, p. 35.
- b*<sup>1</sup>. First ray of pectoral not prolonged; none of the barbels reaching gill-opening.
- c*<sup>1</sup>. Dorsal 11 or 12; A. 9 or 10-----*oroyae*, p. 35.
- c*<sup>1</sup>. D. 8; A. 6 or 7-----*quechuorum*, p. 36.
- a*<sup>1</sup>. Dorsal entirely in front of the anal; caudal emarginate.
- b*<sup>1</sup>. Dorsal behind the base of the ventrals; head longer than broad by a diameter of the eye.
- c*<sup>1</sup>. Spots as large as or larger than the eye-----*dispar*, p. 35.
- c*<sup>1</sup>. Spots much smaller than the eye-----*punctulatum*, p. 35.
- b*<sup>1</sup>. Dorsal partly over the base of the ventrals; D. 8; A. 12 ----*pardum*, p. 36.

### 39. PYGIDIUM POEYANUM (Cope).

- Trichomycterus rivulatus* COPE, Proc. Acad. Nat. Sci. Phila., 1874, p. 132; Arequipa, Peru; not of Cuvier and Valenciennes.
- Trichomycterus poeyanus* COPE, Proc. Amer. Philos. Soc., 1877, p. 47; Arequipa, Peru; based on specimens in previous reference.
- Pygidium poeyanum* EIGENMANN and EIGENMANN, Nematognathi, 1890, p. 328.

### 40. PYGIDIUM RIVULATUM (Cuvier and Valenciennes).

- Trichomycterus rivulatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846, p. 495; Guasacona.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 274 (copied).—COPE, Proc. Amer. Philos. Soc., vol. 17, 1877, p. 47; Lake Titicaca.
- Pygidium rivulatum* EIGENMANN and EIGENMANN, Proc. Cal. Acad. Sci., ser. 2, vol. 2, 1890, p. 51; Cuzco; Moho and Puno on Lake Titicaca.—EIGENMANN and EIGENMANN, Nematognathi, 1890, p. 330.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 771.
- ?*Trichomycterus incae* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846, p. 496; Rio Guatanai at Cuzco.
- Trichomycterus gracilis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846; Rio Azangaro near Guasacona; Rio Guatanai near Cuzco; Rio Pontezualo near Corolco; Lake Compucilla near Cuzco.—COPE, Proc. Amer. Philos. Soc., vol. 17, 1877, p. 681; Tinta.
- Trichomycterus barbatula* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846, p. 498; Guasacona; Rio Pontezualo near Corolco.
- Trichomycterus pentlandi* CASTELNAU, Anim. Nouv. Amerique Sud, 1855, p. 49, pl. 24, fig. 1; Lake communicating with the Ucayale.
- Trichomycterus pictus* CASTELNAU, Anim. Nouv. Amerique Sud, 1855, p. 59, pl. 24, fig. 2; Lake Titicaca.
- Trichomycterus dispar* GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 273 (part); Lake Titicaca; Rio de Pontezualo; Andes de la Paz; Guasacona, Rio de Azangaro.—GARMAN, Bull. Mus. Comp. Zool., vol. 3, 1875, p. 275; Lake Titicaca.

Habitat: Lake Titicaca; Ucayale and its tributaries.

41. *PYGIDIUM TAENIA* (Kner).

*Trichomycterus taenia* KNER, "Sitzgsber. Akad. Wiss. München, 1863, p. 228."—KNER and STEINDACHNER, Abh. Bayer. Akad. Wiss., 1864, p. 52, pl. 6, fig. 1; Western Slope Peruvian Andes.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 274.

*Pygidium taenia* EIGENMANN and EIGENMANN, Nematognathi, 1890, p. 333.

42. *PYGIDIUM LATICEPS* (Kner).

*Trichomycterus laticeps* KNER, Sitzgsber. Akad. Wiss. München, 1863, p. 228.—KNER and STEINDACHNER, Abh. Bayer. Akad. Wiss., 1864, p. 54, pl. 6, fig. 2 and fig. 1a; Western Slope of Peruvian Andes.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 274.

*Pygidium laticeps* EIGENMANN and EIGENMANN, Nematognathi, 1890, p. 334.

43. *PYGIDIUM OROYAE* Eigenmann and Eigenmann.

## BAGRE-CITO.

Plate 4, fig. 2.

*Pygidium oroyae* EIGENMANN and EIGENMANN, Proc. Cal. Acad. Sci., ser. 2, vol. 2, 1889, p. 51; Oroya; Nematognathi, 1890, p. 334.

Two specimens, field No. 564, 12.7 and 13 cm. in length, from river at Oroya.

Body compressed; caudal peduncle strongly compressed, its least depth 1.31 in head; head broad, depressed, its length equal to its breadth, 5.2 in length; depth of body 5.73; eyes very small, 10.5 in head, 3.5 in interocular space; snout 2.1 in head; interocular 3; barbels short and rather stout, none of them reaching gill-opening. D. 11; A. 9; insertion of dorsal over vent; insertion of anal under middle of dorsal; caudal broad and rounded; ventrals small, close to vent, 2.21 in head; pectoral broad, fan-shaped, 1.23; opercular and subopercular spines well developed.

Color in alcohol: Yellowish, with irregular groups of dark brown spots.

44. *PYGIDIUM DISPAR* Tschudi.

*Pygidium dispar* TSCHUDI, Fauna Peruana, Ichthyol., 1845, p. 22, pl. 3; eastern slope of the Peruvian Andes, at an altitude of 14,000 feet.—EIGENMANN and EIGENMANN, Nematognathi, 1890, p. 335.—STARKE, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, p. 770, 1906.

45. *PYGIDIUM PUNCTULATUM* (Cuvier and Valenciennes).

## BAGRE.

*Trichomycterus punctulatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846, p. 362 (498); pl. 552; river at Lima.

*Pygidium dispar punctulatum* EIGENMANN and EIGENMANN, Nematognathi, 1890, p. 336.

*Pygidium punctulatum* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, p. 771, 1906.

*Pygidium dispar* TSCHUDI var. *punctulatum* STEINDACHNER, Herpet.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 49; Rio Chillón, near Lima.

Two specimens, field No. 265, 14 and 15.4 cm. in length; nine specimens, field No. 213, 5.4 to 9.4 cm. in length, from the Rimac River below Lima; and one specimen, field No. 426, 22.8 cm. in length, from the Rimac near Lima.

Head 5.12 in length; depth 6.5; eye 10 in head, 3 in interocular space; snout 1.3 in head; interocular space 3.16; D. 12, only seven of which are branched, only two of the simple rays discernible without dissection; A. 9, only five of which are branched, and only one of the simple rays discernible without dissection. Body robust, much compressed posteriorly, least depth of caudal peduncle 1.73 in head; head depressed, its breadth 1.22 in its length; distance from tip of snout to insertion of dorsal 1.6 in length; insertion of dorsal slightly posterior to base of ventrals; distance from tip of snout to insertion of anal 1.35 in length, insertion of anal in vertical from posterior base of dorsal; ventrals short, barely reaching vent, 1.90 in head; upper pectoral ray produced into a long filament, length of fin without filament, 1.58 in head.

Color in alcohol: Lavender; body covered with rather large, round, brownish black spots, those on top of head and base of caudal smaller and more numerous. Description based on a specimen 22.8 cm. long.

The validity of this species seems questionable, as it appears to differ from *P. dispar* in little but color, and the variability of coloration in our examples seems to indicate that this character has little value. In the two larger specimens in our collection many of the spots on the sides of the body are as large as or larger than the eye; in the smaller specimens the size of the spots is variable, in some they are mere points thickly sprinkled over the entire body and in others considerably larger and in correspondingly smaller numbers.

#### 46. PYGIDIUM PARDUM (Cope).

*Trichomycterus pardus* COPE, Proc. Acad. Nat. Sci. Phila., 1874, p. 182; Proc. Amer. Philos. Soc., 1877, p. 45; Jequetepeque; Callao Bay.

*Pygidium pardum* EIGENMANN and EIGENMANN, Nematognathi, 1890, p. 337.

#### 47. PYGIDIUM QUECHUORUM Steindachner.

*Pygidium quechuorum* STEINDACHNER, Herpt.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 49, pl. 4, fig. 3, 3a; Rio Chile, near Arequipa, Peru.

## Family LORICARIIDAE.

## KEY TO PERUVIAN GENERA.

- $\alpha^1$ . Dorsal fin, I, 7 to 10; anal I, 3 to 5-----*Chaetostomus*, p. 37.  
 $\alpha^1$ . Dorsal fin, I, 6; anal I, 5 or 6-----*Cycloptum*, p. 37.

## Genus CHAETOSTOMUS Tschudi.

## 48. CHAETOSTOMUS LOBORHYNCHUS (Tschudi).

*Chaetostoma loborhynchus* TSCHUDI, Fauna Peruana, Pisc., 1845, p. 26, pl. 4; Rio Tullumayo, Andes of Peru.

*Chaetostomus loborhynchus* GÜNTHER, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 250.—REGAN, Monograph Fish. Fam. Loricariidae, Trans. Zool. Soc. London, vol. 17, 1904, p. 246.—EIGENMANN, Cat. Freshwater Fishes of Tropical and South Temperate America, 1910, p. 410.

## Genus CYCLOPIUM Swainson.

## 49. CYCLOPIUM SIMONSI (Regan).

*Arges simonsii* REGAN, Monograph Fish. Fam. Loricariidae, Trans. Zool. Soc. London, vol. 17, 1904, p. 317, pl. 21, fig. 9; Huaras, Peru, 10,700 feet.

*Cycloptum simonsii* EIGENMANN, Cat. Freshwater Fish., Tropical and South Temperate America, 1910, p. 417.

## Family POECILIIDAE.

## THE KILLIFISHES.

## KEY TO PERUVIAN GENERA.

- $\alpha^1$ . Ventrals present; jaws with bands of subconical, hooked teeth. *Aplocheilus*, p. 37.  
 $\alpha^1$ . Ventrals absent; teeth in jaws in a single series or in a narrow band; pharyngeal teeth present, slender-----*Orestias*, p. 37.

## Genus APLOCHEILUS McClelland.

## 50. APLOCHEILUS PERUANUS (Regan).

*Haplocheilus peruanus* REGAN, Ann. Mag. Nat. Hist., vol. 12, 1903, p. 626; Perim, Peru, 800 meters.

*Aplocheilus peruanus* EIGENMANN, Cat. Freshwater Fish. Trop. and South Temp. Amer., 1910, p. 454, name only.

## Genus ORESTIAS Valenciennes.

## KEY TO SPECIES.

- $\alpha^1$ . Form elongate, in adult.  
 $b^1$ . Scales granulate.  
 $c^1$ . Mouth large; teeth many-----*cuvieri*, p. 38.  
 $c^1$ . Mouth small; teeth few-----*pentlandii*, p. 39.  
 $b^1$ . Scales striate; mouth small-----*elegans*, p. 40.  
 40656°—Bull. 95—17—4

*a*<sup>1</sup>. Form medium elongate, in adult.

*d*<sup>1</sup>. Scales striate; crown flat; mouth large.....*mülleri*, p. 40.

*d*<sup>2</sup>. Scales smooth, in part; crown convex; mouth small.

*c*<sup>1</sup>. Dorsal rays 15 or 16; anal rays 16 or 17.....*tschudtii*, p. 40.

*c*<sup>2</sup>. Dorsal 13-15; anal rays 13-15.....*agassizii*, p. 40.

*c*<sup>3</sup>. Dorsal rays 13; anal rays 13.....*owenii*, p. 42.

*a*<sup>2</sup>. Form short.

*f*<sup>1</sup>. Belly naked.

*g*<sup>1</sup>. Body rounded; head rounded.

*h*<sup>1</sup>. Mouth small; scales striate.....*olivaceus*, p. 42.

*g*<sup>2</sup>. Body compressed; head angular.

*i*<sup>1</sup>. Scales granulate, in part.

*f*<sup>2</sup>. Snout large; mouth wide.

*k*<sup>1</sup>. Back only partly scaled.....*albus*, p. 42.

*k*<sup>2</sup>. Back entirely scaled.....*neveui*, p. 42.

*j*<sup>1</sup>. Snout narrow; mouth small.....*luteus*, p. 42.

*i*<sup>2</sup>. Scales smooth, in part; back high.....*jussiei*, p. 42.

*f*<sup>3</sup>. Belly covered with scales.

*l*<sup>1</sup>. Body much compressed.....*incae*, p. 42.

#### 51. ORESTIAS CUVIERI Valenciennes.

##### OMANTO.

*Orestias cuvieri* VALENCIENNES, L'Inst., vol. 7, 1839, p. 118; Lake Titicaca.—  
CUVIER AND VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846, p. 168 (225),  
pl. 532.—GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19,  
1895, p. 147, pl. 3, fig. 11 (teeth).—STARKS, Fishes from Ecuador and  
Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 779.

*Orestias cuvierii* COPE, Proc. Amer. Philos. Soc., vol. 17, 1877, p. 44.

One specimen, field, No. 555, 20.8 cm. in length, from Lake Titicaca near Puno.

Head 2 in length; depth 4; eye 6.6 in head, 2 in snout; snout 3.7; interorbital 3.3; length of pectoral 2; base of pectoral 4; D. 16; A. 18; scales 14-41; 23 scales on median line of back in front of dorsal.

Body elongate, slightly compressed; caudal peduncle rather slender, broadening at base of the fin; head large, one-third of length without caudal; crown broad, depressed and concave at occiput and snout, flattened in the middle; snout large, broad, blunt, rounded, nearly twice as long as eye; chin vertical; mouth wide, oblique, cleft reaching below the lower level of orbit; teeth strong, in bands, numerous, hooked, subconical; eye medium; scales of head and shoulder granular; a series of about 20 large vertebral scales in front of the dorsal; scales of the lateral line larger than those on each side of it; belly scaleless. On young individuals all the scales are flat, thin and concentrically striate; the granulation and thickening appear first at the head, then gradually extend farther back. Dorsal origin near halfway from head to caudal; fin low, rounded on upper margin, third ray above origin of anal; anal extending a little farther back than dorsal, in base and fin; pectorals about the size of the

anal, reaching halfway to vent. Caudal broad, hinder margin concave, more deeply indented in the young. (Garman.)

In this individual the caudal peduncle is not slender as in *O. pentlandii*, and the scaling of the head is very different; head naked, save for a few scales on top, cheek, and opercle; body scales anteriorly rugose; naked area on either side of median line of back not so large as in other specimens examined. This species is readily recognized from the others by the elongate head, large mouth, and well-developed teeth.

Color in alcohol, flesh-colored; dusky brownish on back, but much lighter than in our examples of *O. pentlandii*.

Common in Lake Titicaca.

## 52. ORESTIAS PENTLANDII Valenciennes.

### BOGA.

*Orestias pentlandii* VALENCIENNES, L'Inst., vol. 7, 1839, p. 118; Lake Titicaca.—CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846, p. 172 (230), pl. 533.—GARMAN, the Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 148.

*Orestias bairdii* COPE, Journ. Phila. Acad. Nat. Sci., 1785 (1874-81), p. 185; Lake Titicaca.

*Orestias pentlandii* STEINDACHNER, Herpet.-Ichthyol. Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 58, pl. 4, fig. 4.—PELLEGRIN, Bull. Soc. Zool. France, vol. 29, 1904, p. 92.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 779.—PELLEGRIN, Poiss. Lacs Hauts Plateaux de l'Amer. du Sud, 1906, pp. 126, 127, 129, fig. 194.

Four specimens, field No. 554, 18.1, 18.8, 19.5, and 20 cm. in length, from Lake Titicaca, near Puno.

Head 3.38 to 3.46 in length; depth 3.9 to 4.2; eye 5.37 to 5.76; snout 3.2 to 3.5; interorbital 2.58 to 2.68; caudal peduncle 2.68 to 2.88; D., 13-15; A., 15-17; scales about 55.

Body elongate, slightly compressed; caudal peduncle long and slender, broadening at base of caudal, much slenderer than in *O. cuvieri*; head short, broad at occiput, but narrowing toward tip of snout; snout blunt, rounded, chin vertical, lower jaw not projecting so strongly as in *O. cuvieri*; mouth moderate, nearly vertical, cleft of mouth reaching lower level of eye; teeth elongate, hooked, in a single row in jaws, easily broken, comparatively few; interorbital broad, rounded, upper profile of head comparatively straight or with a slight depression in front of eyes; insertion of dorsal slightly nearer base of caudal than posterior border of opercle, or midway between the two; caudal concave; insertion of anal under second dorsal ray. Scales small, thin, somewhat deciduous, those about head and shoulders somewhat rugose, this characteristic of the scales

disappearing posteriorly; side scaled to base of pectoral or lower, the naked area of belly including the base of the anal; front of pectoral naked; top of head to front of eyes fully or partly scaled; area around and in front of eye naked or with several scales; 21-24 scales on median line of back between head and origin of dorsal, 16 or 17 rows between origin of dorsal and origin of anal.

Color in alcohol, back dusky brown; belly fleshy colored, tinged with yellow; fins dusky.

This is said to be a very good food fish.

#### 53. *ORESTIAS ELEGANS* Garman.

*Orestias elegans* GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 149; Lagunas de la Cordillera de la Ascension; small lakes among headwaters of Rimac River.

#### 54. *ORESTIAS MÜLLERI* Valenciennes.

*Orestias mülleri* VALENCIENNES in Cuvier and Valenciennes, Hist. Nat. Poiss., vol. 18, 1846, p. 179 (240).—GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 149; Lake Titicaca.

#### 55. *ORESTIAS TSCHUDII* Castelnau.

*Orestias tschudii* CASTELNAU, Exp. Amer. Sud., Poiss., 1855, p. 51, pl. 27, fig. 1.—PELLEGRIN, Bull. Soc. Zool. France, vol. 29, 1904, p. 92; Poiss. Lacs Hauts Plateaux de l'Amer. du Sud, 1906, pp. 127, 129, fig. 19ii.

Contrary to the opinion of later writers, Pellegrin states that this species differs from *O. agassizii*.

#### 56. *ORESTIAS AGASSIZII* Valenciennes.

##### GARACHITO.

*Orestias agassizii* VALENCIENNES in Cuvier and Valenciennes, Hist. Nat. Poiss., vol. 18, 1846, p. 178 (275); Corocoro.—GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 150.—STEINDACHNER, Herpet.-Ichthyol. Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 58, pl. 3, fig. 3.—PELLEGRIN, Bull. Soc. Zool. France, vol. 29, 1904, pp. 93-94.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 780.—PELLEGRIN, Poiss. Lacs Hauts Plateaux de l'Amerique du Sud, 1907, pp. 19-23, pl. 14, fig. A-D.—EVERMANN and RADCLIFFE, Notes on a Cyprinodont (*Orestias agassizii*) from Central Peru, Proc. Biol. Soc. Washington, vol. 22, 1909, pp. 165-170.

*Orestias ortonii* COPE, Journ. Phila. Acad. Nat. Sci., 1875, p. 186 (1874-1881); Lake Titicaca.

*Orestias frontosus* COPE, Journ. Phila. Acad. Nat. Sci., 1875, p. 187 (1874-1881); Lake Titicaca.

Two specimens, field No. 562, 6.7 and 7.0 in length, from Lake Titicaca, taken at the dock at Puno.

Head and shoulders broad, heavy, and arched in adults, much more 4; interorbital 2.9 to 3; D. 14; A. 15; scales 31-2.

Head 3.37 to 3.56 in length; depth 3 to 3.45; eye 4 in head; snout compressed in the young; mouth small, nearly vertical; cleft of mouth extending to lower level of orbit. This character is subject to considerable variation; in adults it may reach a considerable distance below level of orbit. Jaws with two series of small, simple, conical, hooked teeth, those in the inner row fewer and smaller; in young examples often none or only one or two of the inner series visible.

Origin of dorsal in advance of anal, slightly nearer caudal than base of occiput, situated at distance equal to its base from caudal; caudal truncate or slightly rounded; ventrals absent.

The scales of the largest specimens are large, convex, horny, and smooth anteriorly, becoming smaller, flattened, and finely striate posteriorly; those above pectoral and on sides and top of head are polished; those on sides of caudal peduncle more or less deciduous; breast and belly naked; top of snout and an area around eye, more or less scaleless; scales in transverse series 14 or 15, 20 on median line of back between nape and origin of dorsal, those on cheek arranged in 3 or 4 rows. In young individuals the scales are all very thin, finely striate and not polished.

The coloration of this species is subject to considerable variation, and Pellegrin has described four varietal forms based mainly on these differences in coloration. Individuals from La Fundicion, studied by the present writers,<sup>1</sup> indicate that there are no hard and fast lines of separation.

Color of adults, dusky olive on back and sides; ventral surface white or yellowish white, the duskiness of the sides encroaching on this area in older examples; in some specimens some of the scales on sides, especially on the head and caudal peduncle, have light centers with dusky edges. Some individuals have a broad, indistinct, dark band on sides, margined below with yellow; dorsal and anal dusky, without black areas or blotches; base of dorsal usually jet black; caudal and pectoral dusky to lightish; axil and base white or dusky white, margined with dusky.

Some smaller individuals have quite a distinct dark band from opercle to base of caudal, most distinct on caudal peduncle; dorsal and caudal with a few irregular black areas on rays near base, giving the fin a punctulated appearance. Other specimens have the band more distinct and a row of about a dozen irregular black spots along each side of the back; below these and alternating with them in some specimens there is a second row; the dark blotches are more pronounced and extend nearer to the free margin. Still others have 3 or

<sup>1</sup> Proc. Biol. Soc. Wash., vol. 22, 1909, pp. 165-170.

4 rows of irregular dusky or black blotches on sides, those replacing the horizontal band often more or less coalescent posteriorly; in some of these specimens the dorsal and caudal are only lightly dotted with dusky, in others the spots are almost jet black. Between these various color-patterns are intergrading forms.

**57. ORESTIAS OWENII Valenciennes.**

*Orestias owenii* VALENCIENNES in Cuvier and Valenciennes, Hist. Nat. Poiss., vol. 18, 1846, p. 180 (241); Urcos Lake, Cusco.—GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 152.

**58. ORESTIAS OLIVACEUS Garman.**

*Orestias olivaceus* GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 152; Lake Umayo, Peru.

**59. ORESTIAS ALBUS Valenciennes.**

*Orestias albus* VALENCIENNES, L'Inst., vol. 7, 1839, p. 118.—CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846, p. 180 (242), pl. 537; Lake Titicaca.—GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 153.—PELLEGRIN, Note Poiss., lacs Titicaca et Poopo, Bull. Soc. Zool. France, vol. 29, 1904, p. 94.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 780.—PELLEGRIN, Poiss., Lacs Hauts Plateaux l'Amer. du Sud, 1906, pp. 128, 186, fig. 1944.

**60. ORESTIAS NEVEUI Pellegrin.**

*Orestias neveui* PELLEGRIN, Bull. Soc. Zool. France, vol. 29, 1904, p. 95; Lake Titicaca; Poiss. Lacs Hauts Plateaux l'Amerique du Sud, 1907, p. 24.

**61. ORESTIAS LUTEUS Valenciennes.**

*Orestias luteus* VALENCIENNES, L'Inst., vol. 7, 1839, p. 118.—Cuvier and VALENCIENNES, Hist. Nat. Poiss., vol. 18, 1846, p. 181 (243); Lake Titicaca.—GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 154.—PELLEGRIN, Note Poiss., lacs Titicaca et Poopo, Bull. Soc. Zool. France, vol. 29, 1904, p. 96.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 781.—PELLEGRIN, Poiss., Lacs Hauts Plateaux l'Amer. du Sud, 1906, pp. 128, 127, 134, fig. 194v.

**62. ORESTIAS JUSSIEI Valenciennes.**

*Orestias jussiei* VALENCIENNES in Cuvier and Valenciennes, Hist. Nat. Poiss., vol. 18, 1846, p. 176 (235), pl. 535; Lake Titicaca, Guaracana River, and Lake Chinchoro.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 6, 1868, p. 329.

*Orestias jussieui* GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 155.

**63. ORESTIAS INCAE Garman.**

*Orestias incae* GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zool., vol. 19, 1895, p. 155; Lake Titicaca.

## Family BELONIDAE.

## THE NEEDLEFISHES.

## Genus TYLOSURUS Cocco.

## 64. TYLOSURUS STOLZMANNI (Steindachner).

*Belone stolzmanni* STEINDACHNER, Ichth. Beitr., vol. 7, 1878, p. 21; Tumbes, Peru.

*Tylosurus stolzmanni* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 713.—GILBERT and STARKS, Fishes Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 53.

## Family HEMIRHAMPHIDAE.

## THE BALAOs, OR HALFBEAKS.

## Genus HYPORHAMPHUS Gill.

## 65. HYPORHAMPHUS UNIFASCIATUS (Ranzani).

## CHOELO.

*Hemirhamphus unifasciatus* RANZANI, Nov. Comm. Acad. Sci. Bonon., vol. 5, 1842, p. 326; Brazil.

*Hyporhamphus unifasciatus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 720; vol. 4, 1900, pl. 116, fig. 311.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 52.

One specimen, field, No. 1029, 28.3 cm. in length from Capon.

Head, including mandible, 2.92 in length of body from tip of mandible to base of caudal, 2.47 in length from tip of upper jaw to base of caudal; head from tip of upper jaw 5.36 (4.53); depth 8.5 (7.23); distance from tip of mandible to origin of dorsal 1.24 (1.03); distance from tip of mandible to origin ventrals 1.58 (1.34); eye 7.33 in head, including mandible, 4.53 in head measured from tip of upper jaw; interorbital 6.88 (3.75); pectoral 2.84 (1.55); D. 14; A. 15; scales 52.

Length of mandible from tip of upper jaw less than rest of head, 2.2 (1.2) in head; anal opposite dorsal; ventrals inserted midway between posterior border of eye and base of caudal; lower caudal lobe longest; scales large, dorsal and anal densely scaled.

Color in alcohol, back dusky bluish; sides and belly silvery, tinged with yellow; fins dusky.

## Family EXOCOETIDAE.

## THE FLYINGFISHES.

## KEY TO GENERA.

- $\alpha^1$ . Ventral fins inserted anteriorly, much nearer tip of snout than base of caudal, not used as organs of flight, their tips not reaching nearly to front of dorsal; anal fin long, its base nearly equal to that of dorsal.—*Exocoetus*, p. 44.

a'. Ventrals inserted posteriorly, more or less nearer base of caudal than tip of snout, used as organs of flight, and their tips reaching past middle of base of anal; anal fin short, not equal to dorsal fin-----*Cypsilurus*, p. 44.

### Genus EXOCOETUS Linnaeus.

#### 66. EXOCOETUS VOLITANS Linnaeus.

*Exocoetus volitans* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 316; locality not known.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 734; vol. 3, 1898, p. 2835.—ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 337.—JORDAN and EVERMANN, Fishes Hawaiian Islands, Bull. U. S. Fish Comm., vol. 23, pt. 1, 1903, p. 132, fig. 45.

*Exocoetus chilensis* ABBOTT, Proc. Acad. Nat. Sci. Phila., 1890, p. 472—DELFIN, Cat. Peces de Chile, 1901, p. 44.

Doctor Coker has the following note on some fish eggs:

Eggs were purchased in the market of Arequipa, July 26, 1908. They constitute a common market article known as "cau-cau." According to the fishermen of Mollendo, these are the eggs of the flying fish, "volador," and are found abundantly in the early summer, beginning with October. Large quantities are dried for later use. This specimen of cau-cau, obtained moist in the market, was said to have been freshened by soaking in water. Dry specimens could also be obtained.

Delfin, in his Catálogo de los Peces de Chile (1901, p. 44), states that the common name of *Exocoetus chilensis* Abbott is "pez volador."

Abbott<sup>1</sup> places this species in the synonymy of *E. volitans*; thus it appears that the eggs seen in the market may belong to this species.

### Genus CYPsilURUS Swainson.

#### 67. CYPsilURUS SPECULIGER (Cuvier and Valenciennes).

*Exocoetus exiliens* JENYNS, Zool Voy. *Beagle*, Fish., 1842, p. 122 (not of Gmelin); coast of Peru.

*Exocoetus speculiger* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 19, 1846, p. 94.

*Exocoetus ruftinnis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 19, 1846, p. 99; Païta, Peru.

*Econautes speculiger* JORDAN and EVERMANN, Fish. North and Mid. Amer., vol. 3, 1898, p. 2836.—ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 337.

*Cypsilurus speculiger* JORDAN and SEALE, Fishes Samoa, Bull. U. S. Bur. Fish., vol. 25, 1905 (1906), p. 209, fig. 13.

The flyingfish taken by Charles Darwin off the coast of Peru and identified by Jenyns as *Exocoetus exiliens* Bloch, is undoubtedly this species.

<sup>1</sup> Proc. Phila. Acad. Nat. Sci., 1899, p. 337.

## Family ATHERINIDAE.

## THE SILVERSIDES.

## KEY TO GENERA.

- a<sup>1</sup>. Premaxillaries not freely protractile, the skin of upper jaw mesially continuous with that of the forehead.
- b<sup>1</sup> Teeth simple, pointed, arranged in villiform bands.
- c<sup>1</sup>. Vomerine teeth usually present, at least in the young; dorsal spines 4, distinct.....*Atherinopsis*, p. 45.
- c<sup>2</sup>. No vomerine teeth; first dorsal represented by a single rudimental spine.....*Protistius*, p. 46.
- a<sup>2</sup>. Premaxillaries freely protractile, the skin not continuous with that of the forehead; scales cycloid, of small size (67 to 105), soft dorsal and anal mostly without scales.....*Basilichthys*, p. 47.

## Genus ATHERINOPSIS Girard.

## 68. ATHERINOPSIS REGIUS (Humboldt).

## PEJE-REY DE RIO.

*Atherina regia* HUMBOLDT in Cuvier and Valenciennes, Hist. Nat. Poiss., vol. 10, 1835, p. 352; Coast of Peru.

*Atherina microlepidota* JENYNS, Zool. Voy. *Beagle*, Fish., vol. 2, p. 78, pl. 16, figs. 1, 2, a, b; Valparaiso.

*Gastropterus archaicus* COPE, Proc. Amer. Philos. Soc., vol. 17, 1878, p. 700; Arequipa, Peru.—EIGENMANN, Cat. Freshwater Trop. and South Temp. Amer., 1910, p. 464.

*Pisciregia beardsleei* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 342; Callao.

*Atherinopsis regius* STEINDACHNER, Herpet.-Ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 39; Rio Tambo, southern Peru.—EIGENMANN, Cat. Freshwater Fish. Trop. and South Temp. Amer., 1910, p. 465.

*Gastropterus beardsleei* EIGENMANN, Cat. Freshwater Fish. Trop. and South Temp. Amer., 1910, p. 464.

Two specimens, field No. 427, 11.1 and 12.3 cm. in length, from the Rimac River near Lima.

Head 4.04 in length; depth 5.3 to 5.5; eye 4.5 to 5 in head; snout 2.85 to 3; maxillary 2.85 to 3; interorbital 2.65 to 2.75; pectoral 1.2 to 1.3; ventrals 2.5; D. IV, 1, 11; A. I, 15; scales about 20–90–3.

Head broad, depressed; top of head, cheeks, opercle and suborbital scaled; snout, preorbital and maxillaries naked; teeth in jaws in 3 or 4 series, large, recurved, the outer row somewhat larger than the others; a number of small recurved teeth on vomer, these small and may easily escape detection in the mucus about them; premaxillary not protractile, its skin continuous with that of the forehead; interdorsal space very short; origin of first dorsal slightly anterior to middle of distance from tip of snout to tip of caudal; anterior rays of second dorsal and anal elongate; caudal forked, the lobes not widely diverging; gillrakers short and stout, 4+15.

Color in alcohol: Back dusky olive; a reddish brown lateral stripe, bordered above with bluish, having the same form as in *Chirostoma*; sides and belly lighter than back, yellowish, tinged with silvery; fins dusky.

Humboldt's conclusion that this is the common pejerrey of the Callao market, and that it occurs in large numbers in the ocean within the limits of Peru is doubtless an error. That it is the "pesce rey" reported to occur in the mountain lakes of Peru and in Titicaca; identified by Abbott from specimens from Callao as *Pisciregia beardaleei*; by Cope on specimens from Arequipa as *Gastropterus archaeus*; by Steindachner, on specimens from the Rio Tambo as *Atherinopsis regius*, and by Jenyns, on specimens from fresh water at Valparaíso as *Athernia microlepidota*, appears to us to be true. It is the "peje-rey de Rio," and not one of the salt-water forms which belong to the genus *Basilichthys*. The greatest discrepancy between Jenyns's description of *A. microlepidota* and our specimens is in the depth of the body.

The following additional measurements of our largest specimen, compared with those given by Cope for *G. archaeus*, are illustrative of the closeness with which his description agrees with our specimens. (The comparative measurements taken from Cope's figures are placed in parenthesis following our own.) Head 4.74 (4.74) in total length; distance from tip of snout to origin of ventral fin, 2.67 (2.63), to origin of anal, 1.86 (1.85), to origin of second dorsal, 1.68 (1.73); tip of the pectoral reaching three-fourths of distance from its base to base of ventral, and tip of ventral three-fifths of the distance from its base to insertion of anal.

As indicated by Steindachner, the presence of teeth on the vomer appears to be largely an age character. An examination of examples of *Atherinopsis californiensis*, the species upon which this genus is based, appears to bear out these conclusions.

The scales are small, rather thick; numerous very distinct concentric lines on their outer surface and from four to six well-developed radiating striae on the basal half, rendering them readily distinguishable from the other peje-reys in our collection.

#### Genus PROTISTIUS Cope.

##### 69. PROTISTIUS SEMOTILUS Cope.

*Protistius semotilus* COPE, Proc. Acad. Nat. Sci. Phila., 1874, pp. 66-7; Peruvian Andes, 12,000 feet; Proc. Amer. Philos. Soc., 1877, pp. 700-701.—EIGENMANN, Cat. Freshwater Fish. Trop. and South Temp. Amer., 1910, p. 464.

Cope<sup>1</sup> says that *Gastropterus archaeus*, which we consider synonymous with *Atherinopsis regius*, differs from this species in addition to generic characters noted, "in the large number of soft rays, the smaller eye, narrower interorbital space, etc."

<sup>1</sup> Proc. Amer. Philos. Soc., 1877, p. 701.

Genus **BASILICHTHYS** Girard.

## KEY TO SPECIES.

- $\alpha^1$ . Depth of body 5 to 5.6 in length; five to seven spines in first dorsal; interdorsal space .15 to .175 of the total length-----*affinis*, p. 47.  
 $\alpha^2$ . Body slender, its depth 6.8 in length; 8 spines in first dorsal; interdorsal space .19 of the total length-----*octavius*, p. 49.

**70. BASILICHTHYS AFFINIS (Steindachner).****PEJE-REY.**

Plate 4, fig. 3.

*Chirostoma affine* STEINDACHNER, Fauna Chilensis, 1898, p. 313; Iquique; Herpet.-Ichthyol. Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 40; Callao, Peru, Market.

*Basilichthys regillus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 339; Callao.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 783; Callao.

*Basilichthys jordani* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 341; Callao.

*Basilichthys affinis* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 342.

Two specimens, field No. 409, 25 and 27 cm. in length, from Callao, and three specimens, No. 09620, 19 to 21 cm. in length, from Paracas Bay region of Pisco, taken June 30. This species was spawning at that time. Point Lastre of the chart, locally known as Punta peje-rey, is the favorite fishing ground for these large Atherinoids during their spawning season.

Seven specimens, field No. 09154, 6.1 to 17.3 cm. in length, from Ancon, taken by a haul with the seine (Chinchoro) on the beach.

Head 4 to 4.25 in length; depth 5 to 5.6; eye 4.3 to 5.5 in head; snout 2.9 to 3.15; interocular 3 to 3.66; D. VI or VII-1, 9 or 10; A. I, 16 or 17; transverse rows of scales 85 (+3); in cross-series between origin of second dorsal and origin of anal 15.

Body somewhat spindle-shaped; head long, depressed; jaws subequal, premaxillaries protractile; premaxillary teeth mainly in two rows, two additional partial series; vomerine teeth variable; in one of the larger specimens they are mainly in three patches, one at the apex and the others at the sides but not symmetrically placed; in other large examples they are quite symmetrical, the definite separations into patches often disappearing. In other examples, especially the smaller individuals, the teeth are few, bristle-like, easily broken off or apparently absent. In those specimens in which large, well-developed teeth are present, there are smaller bristle-like teeth

among them. Maxillary scarcely reaching the vertical from anterior border of eye; eye large, 1.33 in snout.

Scales thin, somewhat deciduous, the concentric lines and radiating striae partially absent or much less distinct than in *Atherinopsis regius*; jaws and snout naked; top of head scaled to front of eyes, these forming a sort of shield.

In examples 20 to 27 cm. in length the insertion of the first dorsal is midway between base of caudal and anterior border of eye; in specimens about 18 cm. in length it is about one diameter of eye nearer base of caudal than tip of snout, and in small individuals it is about midway between tip of snout and base of caudal. In these examples the interorbital space is scarcely as constant as that recorded by Abbott, varying from 15 to 17.5 hundredths of the total length; origin of second dorsal above fifth or sixth anal ray; caudal forked; ventrals short; pectoral 1.45 to 1.55 in head.

Color in alcohol of two large examples from Callao, silvery gray, back above lateral stripe dusky, a median stripe along back and a broad lateral stripe of blue. In the other examples the body has a decidedly brownish wash and the lateral stripe is more distinct. Steindachner records the same coloration for a specimen 18.6 cm. in length from Callao as for our examples from that locality.

That *B. regillus* and *B. jordani* of Abbott are synonymous with this species there seems little doubt. Abbott's statement in description of *B. regillus* that "origin of first dorsal is nearer snout than base of caudal by one-third length of head," should, according to Starks,<sup>1</sup> read, "nearer base of caudal than snout by one-third length of head." The main remaining difference between *B. regillus* and *B. jordani* lies in the reported presence of vomerine teeth. Prof. J. O. Snyder has kindly reexamined Abbott's types and cotypes of *B. regillus*, *octavius*, and *jordani* and has given us the following notes on vomerine teeth:

Type of *Basilichthys jordani*: The right side of the vomer has been destroyed. The center and left side have a few scattered teeth which are about one-fourth as large as the largest teeth on the jaws; they are rather evenly distributed and are not anywhere grouped in patches.

Cotype of *B. jordani*: On the vomer are two classes of teeth. First larger ones, closely opposed and segregated in two patches, one on each side, the patches being dissimilar in size and location, that on the left side being larger, of stronger teeth and more anterior in position. Second, very minute, short, bristle-like teeth scattered over the surface of the bone between the patches of larger teeth.

Type of *B. octavius*: The soft tissue has all been scraped from the vomer. The vomer is very rough on each side and somewhat pitted

<sup>1</sup> Proc. U. S. Nat. Mus., vol. 30, 1906, p. 783.

in the regions occupied by the patches of teeth in the cotype of *B. jordani*.

Type of *B. regillus*: A few minute, very short bristles (teeth) on the vomer.

Cotypes of *B. regillus*: (a) Small teeth in two rather indefinitely outlined patches, one on each side of the vomer. (b) No teeth. Vomer with enlarged, rough surfaces in the region occupied by teeth in (a). (c) A few minute, scattered teeth on vomer. (d) An elongate patch of a few small teeth on each side of the vomer. Four comparatively strong teeth on anterior, central part of bone.

(In all of these specimens the vomer has been more or less severely scraped, as if an attempt to detect teeth by rubbing with a sharp instrument had been made.)

Regarding *Basilichthys affinis*, Abbott writes: "This species apparently closely resembles the preceding. It appears to differ from *B. jordani* in the absence of vomerine teeth, and from *jordani*, *regillus*, and *octavius* in the much shorter head and in position of the first dorsal. Steindachner's description of an example from Callao and our own specimens indicate that these differences do not exist."

#### 71. BASILICHTHYS OCTAVIUS Abbott.

*Basilichthys octavius* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 340; Callao.

### Family MUGILIDAE.

#### THE MULLET.

##### KEY TO GENERA.

- $\alpha^1$ . Orbit with a well-developed adipose eyelid, covering part of the iris; cilia in one or few series, slender; cleft of mouth chiefly anterior—*Mugil*, p. 49.  
 $\alpha^2$ . Orbit without distinct adipose eyelid; jaws with small labial, cilliform, pectinate, movable teeth, in two rows, often traces of a third row present ----- *Neomyxus*, p. 51.

#### Genus MUGIL (Artedi) Linnaeus.

#### 72. MUGIL CEPHALUS Linnaeus.

##### LIZA; LICHTA.

*Mugil cephalus* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 316.—JORDAN and EVERMANN, Fish. North and Mid. Amer., vol. 1, 1896, p. 811.—STEINDACHNER, Fauna Chilensis, 1898, p. 315.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 343.—DELFIN, Cat. Peces de Chile, 1901, p. 48.—STEINDACHNER, Herpet.-ichthyol. Ergebnisse einer Reise nach Südamerika, Denkschr., Akad. Wiss. Wien, vol. 72, 1902, p. 40.—JORDAN and EVERMANN, Fish. Hawaiian Islands, Bull. U. S. Fish. Comm., vol. 23, pt. 1, 1903, p. 140, fig. 48.

- Mugil rammelsbergii* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 20.—DELFIN, Cat. Peces de Chile, 1901, p. 48.  
*Mugil liza* GAY (not Cuvier and Valenciennes) Hist. Chile Zool., vol. 2, 1846, p. 256, I, Atlas Zool., pl. 4 bis, fig. 2, 1854.  
*Mugil mexicanus* STEINDACHNER, Ichth. Beitr., vol. 3, 1875, p. 59, pl. 8.  
*Mugil charlottae* STEINDACHNER, Herpet.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 41, pl. 4, fig. 2, 2a; Guayaquil, Ecuador.

Two specimens, field No. 444, 20.9 and 29.5 cm. long, from Callao; 4, field No. 09153, 10 to 15.6 cm. long, from Ancon, taken on beach with seine; 4, field No. 563, 14.7 to 15.7 cm. long, from the market of Arequipa, stated to be from Rio Tambo; 16, field No. 302, 3.4 to 7.9 cm. long, and 3 specimens, No. 300, 10.7 to 15 cm. long, from Rio de Eten, about 1 mile from the mouth, Eten; 3, field No. 271, 11 to 11.6 cm. long, from Rimac River below Lima; 6, field No. 09428, 4.7 to 8.5 cm. long, and 10 specimens, No. 09429, 3.6 to 4.4 cm. long, from Pacasmayo, where it was abundant; and 21, field No. 73, 3.9 to 4.2 cm. long, from Callao. Everywhere near the mole the water swarmed with these little fishes.

Head 3.6 in length; depth 3.85; eye 4.3 in head; snout 4.33; maxillary 3.85; interorbital 2.24; pectoral 1.73; ventrals 1.91; D. IV-I, 8; A. III, 8; scales 40 (+3)—13.

Body robust, dorsal and ventral outline evenly arched, moderately deep; head depressed, jaws subequal; maxillary reaching vertical from anterior border of eye; a single row of very small slender teeth on outer fleshy edge of each jaw; eye moderate, adipose eyelid well developed, covering eye except pupil; interorbital broad and flat; distance from tip of snout to origin of spinous dorsal 1.98 in length; distal border of soft dorsal and anal concave; caudal forked; ventrals short, tips reaching midway from base to vent; pectoral short, not reaching vertical from origin of spinous dorsal; scales large, regular; head scaled; soft dorsal and anal without scales.

Color in alcohol, back dusky, bluish, sides and belly silvery, centers of scales on sides dusky, forming longitudinal dusky stripes bordered by stripes of silver; fins dusky, base of pectoral dusky. Description of a specimen 29.5 cm. in length from Callao.

Another individual from the same locality, 20.9 cm. in length, has head 3.54 in length; depth 3.95; eye 4 in head; snout 4.36; maxillary 4; interorbital 2.3; pectoral 1.66; ventral 1.92; D. IV-1, 8; A. III, 8; scales 40 (+3)—13.

An example 13 cm. in length from Eten has head 3.4; depth 3.62; eye 4.44; snout 4.15; maxillary 4.15; interorbital 2.38; pectoral 1.55; ventrals 1.82.

Behind the outer row of teeth in the lower jaw, slender bicuspid teeth occur—these can not be made out in the large examples and in

some of the others barely show through the mucous; in small specimens they are easily seen with the lens.

Examples from the Arequipa market were bluish on back, silvery white on belly.

This widely distributed species is undoubtedly the most abundant *Mugil* occurring on the coast of Peru, and is at once recognized by the almost entire absence of scales on the soft dorsal and anal and the longitudinal dark stripes along the rows of scales.

#### Genus NEOMYXUS Steindacher.

##### 73. NEOMYXUS CILIOLABIS (Cuvier and Valenciennes).

*Mugil ciliolabis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 11, 1836, p. 112 (151); Callao de Lima.

*Myxus ciliolabis* GÜNTHER, Cat. Fish. Brit. Mus., vol. 3, 1861, p. 467.

*Neomyxus ciliolabis*, KENDALL and RADCLIFFE, Mem. Mus. Comp. Zool., vol. 85, No. 3, p. 88, April, 1912; Chatham Island.

#### Family SPHYRAENIDAE.

##### THE BARRACUDAS.

#### Genus SPHYRAENA (Artedi) Bloch and Schneider.

##### 74. SPHYRAENA IDIASTES Heller and Snodgrass.

##### AGUJA; PEJE-AGUJA.

*Sphyraena idiaestes* HELLER and SNODGRASS, Proc. Washington Acad. Sci., vol. 5, 1903, p. 190, pl. 2; Seymour Island, Galapagos Archipelago.—SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 354.

One specimen, field No. 09730 (=09405), 53.7 cm. in length, from Guanape North Island, and one specimen, No. 09694, 54 cm. in length, from Lobos de Tierra. According to fishermen, these fishes keep near the shore.

Head 3.03 in length; depth 7.85; eye 7.5 in head; snout 2.42; maxillary 2.83; interorbital 5.8; pectoral 3.33; D. V-I, 9; A. II, 8; scales 20-145-13; 137 pores in lateral line.

Body slender, elongate, fusiform; head slender, conical; snout pointed; lower jaw longer, projecting beyond upper a distance equal to two-fifths diameter of eye; maxillary not reaching vertical from anterior border of eye by a distance equal to diameter of pupil; preorbital narrow, 2 in eye; teeth in jaws in a single series, smooth, compressed, pointed, those on lower jaw longer and stronger; a single stout tooth at tip in front of lower jaw; two elongate teeth on inner premaxillaries, pointed backward, behind these in the same straight line, on palatines there is a row of similar elongate teeth,

becoming smaller posteriorly; eye large; border of preopercle without serrations; distance from tip of lower jaw to origin of first dorsal 2.06 in length; first dorsal spine longest, 4.28 in head; caudal deeply forked; ventrals short, 3.5 in head, tips reaching one-third the distance from base of ventrals to origin of anal; scales small, lateral line with a slight downward curve over pectoral; scales of lateral line large, pores raised; cheeks and opercles scaled, those on cheeks very small.

Color in alcohol: Back and sides above lateral line slaty brown; sides below lateral line and belly salmon red; dorsal, caudal, and anal blackish; pectorals and ventrals dusky yellowish. Description based on a specimen, 53.7 cm. in length, from Guanape, North Island.

### Family POLYNEMIDAE.

#### THE THREADFINS.

#### Genus POLYDACTYLUS Lacépède.

#### 75. POLYDACTYLUS APPROXIMANS (Lay and Bennett).

##### BARBUDO.

*Polynemus approximans* LAY and BENNETT, Beechey's Voyage, Zool. Fish., 1849, p. 57; Mazatlan.

*Polydactylus approximans* EVERMANN and JENKINS, Proc. U. S. Nat. Mus., vol. 14, 1891, p. 137; Guaymas.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 829.—ABBOTT, Proc. Acad. Nat. Sci. Phila., 1899, p. 344.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 783.

One specimen, field No. 1015, 20.7 cm. long, from Tumbes, taken with a casting net ("ataraya") at the mouth of the Tumbes River.

Head 3.33 in length; depth 3.26; eye 4.1 in head; snout 5; maxillary 2.18; interorbital equal to eye, 4.1; pectoral equal to head, simple rays much longer, reaching beyond origin of anal; D. VIII-1, 12( $\frac{1}{2}$ ); A. III, 14; scales 6-60-11.

Body deep, compressed, dorsal outline rounded; head short, compressed; snout pointed, projecting beyond maxillaries a distance of at least one-half diameter of orbit; tip of snout on level of middle of eye and falling away very obliquely to maxillaries, the anterior border of which is little in advance of anterior margin of eye; mouth small, center of maxillary falling below center of eye; third dorsal spine longest, 1.45 in head; anterior and posterior rays of dorsal longest, the distal margin semicircular; caudal deeply forked, the lobes longer than head; anal spines very weak; pectoral filaments long, 6 in number.

Color silvery yellow, dusky on back; pectorals black; a black area on opercles.

Pacific coast of America from Guaymas to Peru; a common food fish, known from Guaymas, Mazatlan, Chiapam, Punta Arenas, Panama, Guayaquil, Tumbes, and Callao.

## Family SYNGNATHIDAE.

### THE PIPEFISHES.

#### Genus SIPHOSTOMA Rafinesque.

##### KEY TO SPECIES.

- $\sigma^1$ . D. 40 or 41; dorsal rays  $1\frac{1}{2}+8$ ; body rings  $18+42$ ; head and body 2.60 in total length ..... *aciculare*, p. 53.  
 $\sigma^2$ . D. 35-37; body rings 20 or  $21+50$ ; body 1.5-1.67 in tail..... *blainvilliana*, p. 53.

#### 76. SIPHOSTOMA ACICULARE (Jényns).

##### AGUJA.

*Syngnathus acicularis* JENYNS, Zool. Voy. *Beagle*, Fishes, 1842, p. 147, pl. 27, fig. 3; Valparaiso.—GUICHENOT in Gay, Hist. Chile, Zool., vol. 2, 1845, p. 347.—STEINDACHNER, Fauna Chilensis, 1898, p. 331.

*Siphostoma aciculare* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 338.

Four specimens, field No. 09156, 13.5-15.3 cm. long, from Ancon, taken with seine on beach, seem to be referable to this species.

Head 7.28 to 7.45 in total length; head and trunk 2.6; trunk 4.02; snout 2 to 2.1 in head; eye 7 to 8; pectoral 4 to 4.2; D. 40-1; dorsal rings  $1\frac{1}{2}+8$ ; body rings  $18+42$ . Nuchal plates with a median ridge; dorsal fin commencing slightly in advance of vent; anal very small; caudal well developed. Color in alcohol brown, dorsal translucent.

#### 77. SIPHOSTOMA BLAINVILLIANA (Eyedoux and Gervais).

*Syngnathus blainvillianus* EYDOUX and GERVAIS, Guerin, Mag. Zool., vol. 4, 1837, pl. 17; Voyage *Favorite*, Zool., 1839, p. 79, pl. 32.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 8, 1868, p. 162.

*Syngnathus blainvillleanus* GAY, Hist. Chile, Zool., vol. 2, 1848, p. 348.

*Leptonotus blainvillet* KAUP, Pophobranchii of Brit. Mus., 1856, p. 46; Peru.

*Syngnathus (Leptonotus) blainvillianus* STEINDACHNER, Fauna Chilensis, 1898, p. 331.

*Leptonotus blainvillianus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 338.

This species is recorded from Peru, Chile, India, Auckland Islands, and New Zealand.

## Family SCOMBRIDAE.

### THE MACKERELS.

##### KEY TO GENERA.

- $\sigma^2$ . Caudal peduncle without median keel on each side; dorsal fins well separated, the interspace being less than half the length of the head; spinous dorsal short, of 9 to 12 spines..... *Scomber*, p. 54.  
 40656°—Bull. 95-17—5

- a. Caudal peduncle with median keel; a small keel above and one below this; pectoral usually inserted below eye.
- b. Teeth of jaws slender, subconical, little, if at all, compressed; gillrakers numerous; corselet distinct; pectorals inserted low; vomer toothless; palatines with a single row of rather strong conical teeth—*Sarda*, p. 55.
- b. Teeth of jaws strong, subtriangular or knife-like, more or less compressed; villiform teeth on vomer and palatines; gillrakers comparatively few; pectorals inserted near level of eye; body elongate—*Scomberomorus*, p. 55.

### Genus SCOMBER Linnaeus.

#### 73. SCOMBER JAPONICUS Houttuyx.

#### OABALLA.

#### Plate 5, fig. 1.

*Scomber japonicus* HOUTTUYX, Verh. Holland. Maatsch. Weet., vol. 20, pl. 2, 1782, p. 331; Japan.—JORDAN and EVERMANN, Fishes Hawaiian Islands, Bull. U. S. Fish Comm., vol. 23, pt. 1, 1903, p. 169.—SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 360.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 783.—EVERMANN and KENDALL, A Comparison of the Chub-Mackerels of the Atlantic and Pacific Oceans, Proc. U. S. Nat. Mus., vol. 38, 1910, pp. 827-828.

*Scomber colias* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 344.—DELFIN, Cat. Peces de Chile, 1901, p. 49.—STEINDACHNER, Herpet-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkscher. Akad. Wiss. Wien., vol. 72, 1902, p. 37 (not of Gmelin).

One specimen, field No. 09167, 23.8 cm. in length, from Chimbote, taken with a hook and line near the pier; and one specimen, field No. 09519, 25 cm. in length, from Lobos de Tierra. Head 3.22 in length; depth 4.5; eye 3.6 in head; snout 3.22; maxillary 2.5; inter-orbital 4.73; pectoral 2.36; distance from tip of snout to origin of first dorsal 2.57 in length; distance from first dorsal to origin of second dorsal 3.33; distance from tip of lower jaw to base of ventral 2.66; D. IX-I, II-I-I-I-I; A. I-I, II-I-I-I-I; scales about 16-210-34; gillrakers long and slender, 12+28, longest 1.6 in eye; each gillraker is armed with long slender teeth. Spinous dorsal high, third dorsal spine highest, 2.41 in head; caudal forked; ventrals short, 2.96 in head; pectorals short.

Color in alcohol, back bluish with 25 to 30 wavy, dark-blue streaks extending down to middle of side; below these numerous dark spots, belly pale silvery; axil of pectoral black; area around base of spinous dorsal crossed by 6 narrow black bands.

This species is distinct from the Atlantic form, *Scomber colias* Gmelin, as has been shown by Evermann and Kendall.

Genus *SARDA* Cuvier.79. *SARDA CHILENSIS* (Cuvier and Valenciennes).*CHANCILLA*; *SARAJONE*; *BONITO*.

*Pelamys chilensis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 8, 1831, p. 163; Valparaiso.—GAY, Hist. Chile, Zool., vol. 2, 1848, p. 224.—STEINDACHNER, Ichth. Notizen, vol. 7, 1868, p. 25.—KITAHARA, Journ. Fish. Bur. Tokyo, vol. 6, pt. 1, 1897, p. 3, pl. 4, fig. 10.

*Sarda chilensis* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 3, 1880, p. 27.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 872.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 345.—DELFIN, Cat. Peces de Chile, 1901, p. 50.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 68.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 784.

One specimen, field, No. 09668, 43 cm. long, from Callao.

Head 3.63 in length; depth 4.15; eye 8 in head; snout 2.92; maxillary 2.15; interorbital 3.29; pectoral 2.15; D. XVIII-I, 13-VIII; A. II, 11-VI.

Body fusiform, elongate; head long; snout pointed, conical; jaws subequal; teeth in jaws in a single row, strong, conical, curved, about 40 in each jaw; similar teeth on palatines, none on vomer; maxillary reaching vertical from posterior border of pupil (agreeing with Gilbert and Starks's description of Panama individuals and not with Jordan and Evermann, p. 872, 1896); gillrakers long and slender, 8+16 (in this respect agreeing more closely with Jordan and Evermann); longest gillraker longer than diameter of eye, 2.40 in snout. Corselet well developed; lateral line wavy, curved sharply upward, under posterior third of soft dorsal; ventrals short, 2.96 in head.

Color in alcohol, bluish on back, becoming reddish brown on belly; fins dusky.

Genus *SCOMBEROMORUS* Lacépède.80. *SCOMBEROMORUS SIERRA* Jordan and Starks.*SIERRA*.

*Scomberomorus sierra* JORDAN and STARKS, Fishes of Sinaloa, Proc. California Acad. Sci., ser. 2, vol. 5, 1895, p. 428; Mazatlan.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 874.—GILBERT and STARKS, Fishes of Panama Bay, Mem. Cal. Acad. Sci., vol. 4, 1904, p. 68.

One specimen, field No. 09569, 56 cm. long, from Paita.

Head 4.8 in length; depth 6.5; eye 6.66 in head; snout 2.84; maxillary 1.75; pectoral 1.56 in head, 7.5 in length; D. XVII-16-VIII; A. II, 15-VIII.

Body slender, elongate, somewhat compressed anteriorly; snout pointed; mouth large, oblique; maxillary reaching to vertical from posterior border of orbit; jaws subequal; teeth in jaws in a single row, long, compressed, 33 fully developed teeth in the upper jaw and 30 in the lower; broad bands of villiform teeth on vomer and palatines; gillrakers 3+13.

Distance from tip of snout to first dorsal 4.1 in length; to second dorsal 1.81; height of longest rays of soft dorsal 1.75 in head; soft dorsal and anal falcate; ventrals short, 1.5 in snout; lateral line undulating.

Color in life, bluish above, silvery below; sides with bronze spots.

In spirits our specimen has four rows of round, dusky spots below lateral line, these most distinct before soft dorsal.

### Family XIPHIIDAE.

#### THE SWORDFISHES.

#### Genus XIPHIAS Linnaeus.

##### 81. XIPHIAS GLADIUS Linnaeus.

*Xiphias gladius* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 248.—JORDAN and GILBERT, Synopsis, 1883, p. 420.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 894.—DELFIN, Cat. Peces de Chile, 1901, p. 51.

*Xiphius gladius* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 346.

We know of no record for Peru of this widely distributed species; it has been recorded from the coast of California and from Iquique and Talcahuano. Chile, and undoubtedly occurs within Peruvian waters.

### Family CARANGIDAE.

#### THE PANJANOS OR PAMPANOS.

##### KEY TO GENERA.

- ♂<sup>1</sup>. Premaxillaries not protractile (except in very young); soft dorsal similar to anal; lateral line unarmed; dorsal spines feeble, 7 in number, connected; anal spines weak; pectoral fins long-----*Neptomenus*, p. 57.
- ♂<sup>2</sup>. Premaxillaries protractile.
  - ♂<sup>1</sup>. Anal fin much shorter than soft dorsal; its base not longer than abdomen; pectoral fin short, not falcate.
    - ♂<sup>1</sup>. Maxillary with a distinct supplemental bone; membrane of dorsal spines persistent-----*Seriola*, p. 58.
    - ♂<sup>2</sup>. Maxillary without supplemental bone-----*Trachinotus*, p. 62.
  - ♂<sup>2</sup>. Anal fin about as long as soft dorsal, its base longer than abdomen; maxillary with a supplemental bone; lateral line arched anteriorly, usually armed posteriorly; pectoral long, falcate—

d<sup>4</sup>. Dorsal and anal each with a single detached finlet; body slender.

*Decapterus*, p. 58.

d<sup>5</sup>. Dorsal and anal without finlets.

e<sup>1</sup>. Lateral line with well-developed scutes for its entire length; body elongate.....*Trachurus*, p. 59.

e<sup>2</sup>. Lateral line with scutes on its straight posterior portion only (these sometimes very few and small, especially in those species with the body much compressed).

f<sup>1</sup>. Body oblong or more or less elevated, not as below; teeth of jaws in few series, or in one series, unequal, or at least not forming villiform bands, outer series above usually enlarged, lower teeth usually uniserial; vomer and palatines with teeth; maxillary broad.....*Caranx*, p. 61.

f<sup>2</sup>. Body broad-ovate, very strongly compressed, its outlines everywhere trenchant, anterior profile nearly vertical, scutes almost obsolete.....*Vomer*, p. 62.

e<sup>3</sup>. Lateral line without any scutes; body short and elevated, strongly compressed.....*Selene*, p. 62.

### Genus NEPTOMENUS Günther.

#### 52. NEPTOMENUS CRASSUS Starks.

##### COJINOBA; COJINOBITA.

*Neptomenus crassus* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 784, fig. 8; Callao, Peru.

Three specimens, field Nos. 09660, 09662, and 09664, respectively, 20.8, 23, and 26 cm. in length, from Callao, and two specimens, field Nos. 543-4, 18.5 and 16.8 cm. in length, from Mollendo.

Head 2.75 to 3.3 in length; depth 3 to 3.3; eye 4 to 5 in head; snout 3.55 to 3.85; maxillary 3 to 3.25; interorbital 3 to 3.25; pectoral 1 to 1.15; D. VII, 1, 25-7; A. II, 18-21; scales small, about 15-85 to 90-33.

Measurements of an individual 26 cm. in length from Callao: head 2.96 in length; depth 3.1; eye 4.75 in head; snout 3.73; maxillary 3.22; interorbital 3.03; pectoral 1; D. VII, 1, 27; A. II, 27; scales 15-85-33, pores 90.

Body short, rather deep, compressed, ventral outline more strongly arched than dorsal, base of anal oblique, caudal peduncle slender, its depth equal to diameter of eye; head large; snout blunt, broadly rounded; interorbital broad, convex, 1.5 times horizontal diameter of eye; eye large, center of eye on level with tip of upper jaw; mouth moderate, oblique; maxillary reaching nearly to the vertical from the anterior border of the pupil; maxillary not protractile, skin of tip of snout continuous with that of upper lip; teeth five, villiform, in a single row in each jaw; no teeth on vomer or palatines, jaws subequal; nostrils small, close together, nearer tip of snout than anterior margin of eye; preorbital very narrow, one-half diameter of pupil;

entire margin of preopercle with fine, rather widely separated, denticulations, these covered by membranes or the tips rarely projecting; vertical border of preopercle concave, the angle evenly rounded, gill-rakers long and slender, longest 1.75 in eye, 6+17; scales small, cycloid, regular in arrangement; lateral line nearly straight; cheek and opercle with thin scales, rest of head naked. Dorsal spines weak, short, fitting into a groove, anterior rays of soft dorsal and anal longest, longest rays about 3 in head; caudal deeply forked; anal spines very weak; ventrals short, their tips reaching midway from base of ventrals to posterior border of vent; pectoral long, falcate, tip reaching to above origin of anal.

Color in alcohol: Brownish, dusky on back and light on belly; top of head black; fins dusky, axil of pectoral dark. Smaller individuals are silvery in coloration.

Doctor Coker states these are small individuals of a large species of fair rank.

This species resembles very closely *N. brama* from New Zealand.

#### Genus *SERIOLA* Cuvier.

##### 33. *SERIOLA PERUANA* Steindachner.

*Seriola peruana* STEINDACHNER, Ichth. Beitr., vol. 11, 1881, p. 13, fig. 1, 1a; Callao.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 347.

#### Genus *DECAPTERUS* Bleeker.

##### 34. *DECAPTERUS SCOMBRINUS* (Valenciennes).

#### JUREL FINO.

*Caranx scombrinus* VALENCIENNES, Voy. de la *Venus*, 1846, p. 332, pl. 7, fig. 1; Galapagos Islands.

*Decapterus scombrinus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 908.

*Decapturus scombrinus* SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 362.

One specimen, field No. 09676, 28.5 cm. in length, from Lobos de Afuero.

Head 3.54 in length; depth 4.75; eye 4.1; snout 3.45; maxillary 3.04; interorbital 5.51; pectoral 1.52; D. VIII-I, 33-1; A. II-I, 28-1; scutes 33.

Body fusiform, caudal peduncle narrow, depressed, its height 1.5 in eye; snout pointed; eye moderate, nearly as long as snout; mouth oblique; maxillary not reaching vertical from anterior border of eye; teeth in upper jaw very small, few in number in front of jaw; a single row of larger teeth in lower jaw; no teeth on vomer and palatines; a median, longitudinal row on the tongue.

Scales small; cheeks and opercles scaly, rest of head naked; lateral line with a moderate arch becoming straight above fourth anal ray; scales of lateral line enlarged; scutes rather weak.

Dorsal spines weak, fitting into a groove; first spine very weak; fourth dorsal spine longest, 2.68 in head; anterior soft rays of dorsal and anal longest; dorsal and anal each with a detached finlet; caudal forked; ventrals small, their tips reaching one-third the distance from base to soft rays of anal.

Color in alcohol, dusky blue on back becoming silvery, tinged with yellow on belly; fins dusky; a dark area at tip of opercle and in axil of pectoral.

We have provisionally identified this species as *D. scombrinus*. It appears to agree very well with Snodgrass and Heller's description of individuals from the Galapagos Islands. The fin counts of our specimen agree more closely with those given in their table of measurements<sup>1</sup> than with those given in the description. We have compared this specimen with an example of *D. sanctae-helenae*, 12½ inches long, from Easter Island, from which it differs in having the body not tapering so sharply anteriorly and posteriorly; the head longer, snout not so pointed, eye smaller, and the interorbital narrower.

Genus TRACHURUS Rafinesque.

85. TRACHURUS SYMMETRICUS (Ayres).

JUREL; JUREL-OITO.

Plate 5, fig. 2.

*Caranx symmetricus* AYRES, Proc. California Acad. Sci., vol. 1, 1855, p. 62.

*Caranx (Trachurus) cuvieri* STEINDACHNER, Ichth. Beitr., vol. 1, 1875, p. 16; Talcahuano, Callao, Juan Fernandez, Galapagos.

*Trachurus picturatus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 909; not of Bowdich.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 346.—DELFIN, Cat. Peces de Chile, 1901, p. 54.

One specimen, No. 09714, 44 cm. in length, and three specimens, No. 413, 11.3 to 14.2 cm. in length, from Callao, and one specimen, No. 09489, 9.2 cm. in length, and two specimens, No. 09454, 7.3 and 7.7 cm. in length, from Lobos de Afuera.

Head 3.27 in length; depth 4.2; eye 7.1 in head; snout 3.5; maxillary 2.9; interorbital 5.73; pectoral 1.1; D. VIII-I, 33; A. II-I, 28; scutes in curved part of lateral line, 54; in straight part, 47; length of curved part lateral line, 1.06 in straight part.

Body elongate, spindle-shaped (compressed in the young); caudal peduncle very slender, its depth about 2 in eye; head large, snout

<sup>1</sup> Shore Fishes, Galapagos Islands, p. 363.

pointed, lower jaw projecting about two-thirds diameter of pupil beyond upper; eye large, its horizontal diameter nearly as long as snout, longer than interorbital width; mouth large, maxillary reaching vertical from anterior border of eye, posterior edge broad, one-half diameter of eye; teeth small, conical, in a narrow band in each jaw, the bands separated by a short interspace in front of jaws; teeth on vomer, palatines and tongue minute; nostrils small, close together, above and a little in front of eyes; border of preopercle with fine denticulations, vertical border nearly straight, angle rounded.

Spinous dorsal fitting into a groove; third dorsal spine longest, 2.1 in head; anterior rays of dorsal and anal longest; caudal deeply forked; two strong spines before anal, connected by membrane; tips of ventrals reaching halfway from their base to second anal spine; pectoral long, falcate, nearly as long as, or equaling, length of head. Scales small, lateral line armed throughout with plates, those anteriorly crowded, those on straight part each armed with a strong spine; little difference in height of scutes on curved and straight portion of lateral line. Color in alcohol: Back dusky, becoming silvery on sides and belly; ventral surface tinged with yellow; border of opercle above base of pectoral black.

This description is based on a specimen 44 cm. long from Callao.

Measurements of an individual 14.2 cm. in length; head 2.95 in length; depth 3.87; eye 3.45; snout 3.45; maxillary 2.92; interorbital 6.33; pectoral 1.26; scutes 47+47; D. VIII-I, 32; A. II-I, 28.

An examination of individuals in the United States National Museum appears to bear out the statement that the common Mediterranean and North Sea or Atlantic form are distinct; the latter and the Japanese species are similar but distinct from the species found on the Pacific coast of America. In the examples examined it was found that in the Japanese species the scutes were 35 or 36+34 or 35; in an individual from the North Sea 35+36; in the Mediterranean 41 or 42+42; in the species found on the Pacific coast of America 46 to 56+42 to 51.

As the original description of *T. trachurus* was based on specimens from the Mediterranean, it appears that this name should replace *T. mediterraneus*, the common species found there. In that case the North Atlantic form would become *T. semispinosus* (Nilsson) and our Pacific form *T. symmetricus*. A much larger and more widely distributed lot of specimens is needed, as the species appears to be quite variable.

*T. symmetricus* is found on the west coast of America from California to Chile and the Galapagos Archipelago.

Genus *CARANX* Lacépède.

## KEY TO SPECIES.

- $\sigma^1$ . Not more than 25 rays in dorsal and 20 in the anal; D. VIII-I, 23; A. II-I, 20; developed scutes 47 to 50; breast scaly-----*caballus*, p. 61.  
 $\sigma^2$ . Dorsal rays more than 25; anal rays more than 20; D. IX-I, 28; A. II, 28 -----*peruanus*, p. 62.

86. *CARANX CABALLUS* Günther.

Plate 5, fig. 3.

*Trachurus boops* GIRARD, Pacific R. R. Surv., vol. 10, Fish., 1858, p. 108; San Diego; not *Caranx boops* Cuvier and Valenciennes.

*Caranx caballus* GÜNTHER, Fish. Centr. Amer., 1869, p. 431; Panama.—EVERMANN and JENKINS, Proc. U. S. Nat. Mus., vol. 14, 1891, p. 138; Guaymas.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 922.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 78.

*Caranx girardi* STEINDACHNER, Ichth. Notizen, vol. 14, 1860, p. 25; San Diego.

*Caranx boops* GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 261.

One specimen, field No. 09693, 42 cm. long, from Lobos de Tierra, taken with a trolling line along with "Sierras."

Head 3.55 in length; depth 3.55; eye 4.65 in head; snout 3.58; maxillary 2.51; interorbital 3.21; pectoral long, falcate, 2.8 in length; D. VIII-I, 23; A. II-I, 20; scutes 47.

Body elongate, not strongly compressed; arch of dorsal and ventral outline equal; caudal peduncle depressed, its least height about one-half its breadth; head short, snout pointed, upper profile convex; eye large; adipose eyelids well developed; mouth small; jaws equal; maxillary reaching vertical from anterior border of pupil, its greatest breadth equal to diameter of that portion of eye not covered by adipose eyelid; teeth small, villiform, in a narrow band in the upper jaw, outer row slightly larger; in a single row in lower jaw; small teeth on tongue, vomer, and palatines.

Scales small, a small area on cheek and upper part of opercle scaled, rest of head naked; breast scaly; curve of lateral line low, becoming straight under origin of soft dorsal; scutes on caudal peduncle stout, very broad, from below last ray of dorsal to base of caudal, six scutes; pectoral much longer than head, tip reaching to below ninth dorsal ray; ventrals very short, tips reaching halfway from base to first anal spine. Color in alcohol, dusky blue or green on back; belly silvery tinged with golden; a black area on posterior border of opercle above base of pectoral; axil of pectoral black; fins dusky.

This individual agrees very well with an example a foot long from Panama.

This species is found from San Diego to Peru and the Galapagos Archipelago.

87. *CARANX PERUANUS* Tschudi.

*Caranx peruanus* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 19.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 346.

A doubtful species; recorded by Tschudi, also by Abbott, from Peru.

Genus *VOMER* Cuvier and Valenciennes.88. *VOMER SETIPINNIS* (Mitchill).

*Zeus setipinnis* MITCHELL, Trans. Lit. Philos. Soc. New York, 1815, p. 384; New York.

*Vomer setipinnis* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 934; vol. 4, 1900, p. 144, fig. 392.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 80.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 786.

*Vomer gabonensis* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 347; not of Guichenot.

Genus *SELENE* Lacépède.89. *SELENE VOMER* (Linnaeus).

## CABALLITO.

*Zeus vomer* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 266; America.

*Selene vomer* EVERMANN and JENKINS, Proc. U. S. Nat. Mus., vol. 14, 1891, p. 138; Guaymas.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 936; vol. 4, 1900, pls. 144, 145, figs. 393, 393a.—GILBERT and STARKS, Fishes of Panama Bay, Mem. Cal. Acad. Sci., vol. 4, 1904, p. 82.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 786.

A single small example, field No. 1002, 6.5 cm. in length, from Tumbes, taken with a casting net at the mouth of the Tumbes River. There are 22 dorsal and 19 anal rays; the filamentous dorsal spine is 0.86 total length; ventrals 2.82, filamentous.

Genus *TRACHINOTUS* Lacépède.90. *TRACHINOTUS PALOMA* Jordan and Starks.

## PAMPANO.

Plate 6, fig. 1.

*Trachinotus paloma* JORDAN and STARKS in Jordan, Fishes of Sinaloa, Proc. Cal. Acad. Sci., ser. 2, vol. 5, 1895, p. 437.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 945.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 84.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 786.

One specimen, field No. 09725, 38 cm. long, from Lobos de Tierra. Head 4.36 in length; depth 2.6; eye 5.66 in head; snout 3.4; maxillary 2.83; pectoral 1.21; D. VII-I, 25; A. II-I, 28.

Body deep, strongly compressed, greatest depth under origin of soft dorsal; dorsal outline strongly and evenly arched; snout bluntish; interorbital high, evenly arched, somewhat compressed; eye small, anterior in position; mouth moderate, nearly horizontal; jaws subequal; maxillary reaching vertical at middle of eye; teeth in lower jaw in a narrow villiform band, those in upper jaw small, confined mainly to a single row; angle of preopercle rounded, with a long downward curve. Scales small, smooth; lateral line nearly straight; head without scales. Dorsal spines short, stout, not connected by membrane; soft dorsal and anal falcate; caudal forked; ventrals small, their tips reach midway from base to origin of anal; pectorals short. Gillrakers slender, 5+12, the last three given in this count are rudimentary, the longest is about half the diameter of the eye.

Color in alcohol: Back dusky bluish; sides and belly silvery, tinged with salmon or yellowish; head and fins tinged with salmon; top of head, dorsal, caudal, and pectorals, dusky.

Cape San Lucas, Mazatlan, southward to Peru.

### Family STROMATEIDAE.

#### THE FIATOLAS.

##### KEY TO GENERA.

- $\alpha^1$ . Ventral fins present in the adult; esophagus with longitudinal plications; lateral line curved anteriorly, becoming straight before reaching the caudal peduncle; body ovate.....*Leirus*, p. 63.  
 $\alpha^2$ . Ventral fins absent in the adult; esophagus without longitudinal plications; gill membranes not joined to the isthmus; pelvis not projecting as a spine.....*Stromateus*, p. 64.

#### Genus LEIRUS Lowe.

##### 91. LEIRUS PERUANUS (Steindachner).

*Centrolophus peruanus* STEINDACHNER, Ichth. Beitr. (I), Sitzb. Akad. Wiss. Wien, vol. 69, 1874, p. 10; Callao; Fauna Chilensis, 1898, p. 299.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 347.

*Leirus peruanus* FORDICE, Rev. Amer. Stromateidae, Proc. Acad. Nat. Sci. Phila., 1894, p. 317.—DELFIN, Cat. Peces de Chile, 1901, p. 58.

*Lirus peruanus* REGAN, Ann. Mag. Nat. Hist., (7) vol. 10, 1902, p. 200.

Genus *STROMATEUS* Linnaeus.92. *STROMATEUS MACULATUS* Cuvier and Valenciennes.

*Stromateus maculatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 9, 1833, p. 296 (399); Valparaiso.—JENYNS, Zool. Voy. *Beagle*, Fish., 1839, p. 74.—GAY, Hist. Chile, Zool., vol. 2, p. 248, Atlas Ichth., 1854, pl. 3bis, fig. 1.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 2, 1860, p. 398.—STEINDACHNER, Fauna Chilensis, 1898, p. 299.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 337.—DELFIN, Cat. Peces de Chile, 1901, p. 57.—REGAN, Fish. Fam. Stromatidae, Ann. Mag. Nat. Hist., ser. 7, vol. 10, 1902, p. 204.

## Family CHEILODIPTERIDAE.

## THE CARDINAL FISHES.

Genus *AMIA* Gronow.93. *AMIA RETROSELLA* GILL.

*Amia retrosella* GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 251; Cape San Lucas.

*Apogon retrosella* JORDAN, Fishes of Sinaloa, Proc. California Acad. Sci. 1895, p. 442, pl. 37.—JORDAN and EVERMANN, Fishes of North and Mid. America, vol. 1, 1896, p. 1108.

Four specimens, field No. 09446, 6.8 to 7.6 cm. long, from Lobos de Afuera.

Head 2.4 in length; depth 2.85; eye 3.42 in head; snout 4; maxillary 1.95; interorbital 3.42; D. VI-I, 9; A. II, 8; scales  $2\frac{1}{2}$ -25 (+4)-9.

Body angular, rather thick anteriorly, somewhat compressed posteriorly; caudal peduncle long, rather broad, its depth 2.5 in head; head large; mouth large, oblique, the maxillary reaching past the vertical from posterior border of pupil; eye very large, its diameter greater than the length of the snout; teeth small, the outer row little enlarged; interorbital broad, flat, equal to diameter of eye; vertical border of preopercle finely serrulate. Spinous dorsal low, second spine longest, 2.75 in head; soft dorsal higher, 1.8 in head; caudal lunate; anal spines weak, the second one-half longest ray; ventrals under pectorals, tips reaching to base of anal; pectorals longer than ventrals, their tips reaching above middle of anal, length 1.6 in head.

Color in alcohol, dusky yellow, everywhere punctulate with brown; a black stripe from eye around snout; spinous dorsal tipped with dusky; a large area on distal part of soft dorsal dusky black; a short black bar from middle of soft dorsal to below lateral line. (The above description is based on the largest specimen.)

Color in life, a bright but thinnish crimson, speckled dusky-like silver showing through a thin crimson film; crimson color and dusky specks show chiefly on posterior margins of scales; silver showing chiefly in centers; less dusky below; a short black bar on upper half

of body, reaching ventrally from beneath middle of second dorsal; spinous dorsal with a rather indefinite black spot on its anterior part; soft dorsal tipped with black anteriorly; caudal sometimes slightly tipped with black; a horizontal black stripe, varying in distinctness in different specimens, passing from eye to eye around end of snout.

A comparison of these specimens with examples of *A. dovii* from Perico Island, Panama Bay, leads us to the same conclusion as that reached by Gilbert and Starks in Fishes of Panama Bay, that the only apparent difference between the two species is one of coloration. These examples of *A. dovii* have a brown area on caudal peduncle; soft dorsal and anal tipped with dusky black; a very indistinct trace of a band across opercles, through eye, around tip of snout.

### Family SERRANIDAE.

#### THE SEA BASSES.

##### KEY TO GENERA.

- $\alpha^1$ . Maxillary with a distinct supplemental bone (rarely obscured by the skin); dorsal usually divided or deeply notched.
  - $b^1$ . Inner teeth of jaws not depressible or hinged.
    - $c^1$ . Canine teeth more or less developed..... *Acanthistius*, p. 96.
    - $c^2$ . No canine teeth..... *Hemilutjanus*, p. 67.
  - $b^2$ . Inner teeth of jaws depressible or hinged.
    - $d^1$ . Parietal crests not produced forward on the frontal.
      - Epinephelus*, p. 69.
    - $d^2$ . Parietal crests produced forward on the frontals.
      - $e^1$ . Frontals with a process or knob on each side behind the inter-orbital area; premaxillaries fitting into a cavity at anterior extremity of frontals; anal rays III, 8, rarely III, 9..... *Alphestes*, p. 69.
      - $e^2$ . Frontals without processes on the upper surface; parietal crests extending to between orbits; premaxillary processes not extending to the frontals. Anal fin elongate, its rays III, 11 or III, 12, (very rarely III, 9 or III, 10)..... *Mycteroperca*, p. 70.
- $\alpha^2$ . Maxillary without supplemental bone.
  - $f^1$ . Gillrakers comparatively short and wide apart; lateral line not running close to the back.
    - $g^1$ . Dorsal rays XVI, 16; anal rays III, 13; palatine teeth absent..... *Epelytes*, p. 71.
    - $g^2$ . Dorsal rays X, 11 to 15; anal rays usually III, 7.
      - $h^1$ . Ventral fins inserted below or more or less behind axil of pectoral; branchiostegals 7.
        - $i^1$ . Dorsal fin with 4 or 5 spines produced in long filaments; dorsal rays X, 12; or X, 13; preopercle evenly serrate; preorbital comparatively broad; top of head, cheeks, and preorbital finely and closely scaled to tip of snout; snout long and low, the lower jaw much projecting; caudal lunate; scales rather small; cranium with a large smooth area, much as in *Serranus* and *Prionodes*; body elongate, little compressed; gillrakers few and short.
          - Cratinus*, p. 72.

- l*<sup>2</sup>. Dorsal without long filamentsous spines, not more than one of its spines specially produced ----- *Paralabrax*, p. 73.
- h*<sup>2</sup>. Ventral fine anterior, inserted more or less in advance of axil of pectoral, well separated; upper half of pectoral fin usually vertically truncate.
- f*<sup>1</sup>. Preopercle with numerous strong diverging spines at its angle, these spines diverging from one or two centers; preorbital broader than maxillary, which is widest near its middle; scales rather large----- *Diplectrum*, p. 75.
- f*<sup>2</sup>. Preopercle simply and rather finely serrate; preorbital narrow ----- *Prionodes*, p. 76.
- f*<sup>3</sup>. Gillrakers (in American species) very long, slender, and close set; lateral line running close to the back.
- k*<sup>1</sup>. Dorsal spines 9, all low, the soft rays about 9. Caudal fin deeply forked, the lobes produced; scales small, ctenoid; ventrals long, inserted behind axil of pectoral; maxillary scaly; frontal region flattish, the supraoccipital crest very prominent *Paranthias*, p. 78.
- k*<sup>2</sup>. Dorsal spines 10 or more; scales not very small; preopercle angular, with salient teeth at its angle; one or more dorsal spines sometimes filamentous; ventral fins long----- *Hemianthias*, p. 79.

### Genus ACANTHISTIUS Gill.

#### 94. ACANTHISTIUS PICTUS (Tschudi).

##### OVERLO.

Plate 6. fig. 2.

*Plectropoma pictum* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 5; Coast of Peru and Chile.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 1, 1859, p. 164.

*Alphestes pictus* JORDAN and SWAIN, Proc. U. S. Nat. Mus., vol. 7, 1884, p. 395.

*Acanthistius pictus* BOULENGER, Cat. Fish. Brit. Mus., vol. 1, 1895, p. 140.—STEINDACHNER, Fauna Chilensis, 1898, p. 282.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 348.—DELFIN, Cat. Peces de Chile, 1901, p. 60.—STEINDACHNER, Herpet.-Ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, p. 28, 1902; Lima, Peru.

Two specimens, field Nos. 09414-15, respectively 22.4 and 19.6 cm. in length, from Guanape North Island.

Head 2.43 in length; depth 2.5; eye 6 in head; snout 3.36; inter-orbital 7.25; maxillary 2.18; pectoral 1.5; D. XI, 18; A. III, 9; scales 27-135-65.

Body short, compressed, rather deep, dorsal outline strongly arched; depth of caudal peduncle about 3 in head; upper profile of head from tip of snout to base of dorsal, straight or slightly concave; lower jaw slightly projecting; mouth large, protractile; tip of

ne  
73. Maxillary reaching to or behind vertical from posterior border of  
of  
fir  
apil; patches of villiform teeth on jaws, vomer, and palatines; an  
outer row of enlarged, conical, canine-like teeth in jaws; preopercle  
strongly serrate; serrations on lower border enlarged, antrorse;  
head, body, and soft parts of basal portion of fins covered with  
small ctenoid scales; insertion of dorsal over middle of opercle, third  
dorsal spine longest, 3 in head; soft dorsal evenly rounded, its height  
2.75 in head; caudal rounded; anal elongate, rounded; second anal  
spine longest, 3.2 in head; tips of ventrals reaching posterior border  
of vent; pectoral broad, subsymmetrical.

Color in life dark, bronze brown with somewhat obscure mottling  
of reddish and a lighter color. When specimens are examined more  
closely, they are found to be variable in coloring. However, the  
general effect may be described as follows: Showing rather indis-  
tinctly through the general body color which is dark brown, appear  
many very irregular reddish bars and spots, and other bars and spots  
of a lighter color, generally a sort of bluish gray. Caudal generally  
distinctly spotted and mottled with bluish gray; the mottling extends  
onto the soft parts of fins but all the outer parts of soft fins are  
usually very dark, almost black; skin above maxillary, underneath  
preopercle, along posterodorsal margin of opercle, and between  
branchiostegals, a dusky reddish-orange; a dark bar extends ob-  
liquely backward across cheek from eye to postero ventral angle of  
preopercle. This bar, though generally quite evident, is not dis-  
tinguishable in some large specimens.

Color in alcohol: Body color seal-brown, lighter ventrally; a  
black bar about one-half diameter of eye in width from side of  
nostril through center of eye to upper border of opercle; a second  
from lower border of eye across cheek to angle of preopercle; a third  
short bar parallel with it on maxillary extending across lower an-  
terior corner of preopercle; a black area between first and second  
opercular spines; upper border of opercle dusky white; indistinct  
traces of bars on body; margins of fins very narrowly edged with  
whitish, easily overlooked; rest of fins body-color.

#### Genus HEMILUTJANUS Bleeker.

##### 95. HEMILUTJANUS MACROPHTHALMOS (Tschudi).

##### OJO DE UVA; PAPANOA.

*Plectropoma macrophthalmos* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 6;  
Lurin, Peru.—KNER, Neue Fische aus Mus. Godeffroy, Sitzb. Akad. Wiss.  
Wien, vol. 58, pt. 1, 1867, p. 711, pl. 1.

*Hemilutjanus macrophthalmos* JORDAN and EIGENMANN, Rev. Serranidae,  
Bull. U. S. Fish Comm., vol. 8, 1890, p. 345.—ABBOTT, Marine Fishes of  
Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 350.

*Pomodon macrophthalmus* BOULENGER, Cat. Fish. Brit. Mus., vol. 1, ed. 1895, p. 144.—STEINDACHNER, Fauna Chilensis, 1898, p. 281.—DELFIN, Cat. Peces de Chile, 1901, p. 60.

Two specimens, field No. 473, 18.8 and 26 cm. in length, from Ballestas Island, region of Pisco, taken with a trammel net fishing in 1 to 3 fathoms; one, field No. 481, 17.8 cm. in length, from Chincha Island, region of Pisco, taken in trammel net; one, field No. 450, 26 cm. in length, from Callao; one, field No. 09720, 27.7 cm. in length, from Mollendo, called "Papanoya," and one, field No. 09555, 35 cm. in length, from Paita.

Head 2.56 in length; depth 2.47; eye 3.8 in head, equal to snout; maxillary 2.2; interorbital 5.5; D. X, 11; A. III, 9; P. 18; C. 19; scales 19-100 (+10)-35.

Body compressed, oblong-ovate; caudal peduncle rather stout, its least depth 2.68 in head; head pointed, lower jaw projecting; maxillary reaching vertical from posterior border of pupil, its greatest width 1.6 in eye; mouth very large, protractile; bands of small villiform teeth on jaws, vomer, and palatines; eye very large, interorbital slightly rounded, 1.33 eye; vertical border of preopercle with small spines on lower portion, becoming smooth on upper portion, lower border and angle with slightly enlarged denticles; first dorsal spine small, 2 in second, which is 1.75 in third; fourth longest, 3 in head; soft dorsal higher than spinous portion, evenly rounded; caudal with its distal border slightly concave; third anal spine longest, 3.33 in head, shorter than the soft rays; ventrals reaching to behind vent, 1.83 in head; pectoral broad, pointed, 1.64 in head.

Scales small, ctenoid, a small area around eye, between eye and snout and on tip of snout, without scales; maxillary covered with small scales, those above lateral line anteriorly, very small, becoming larger below lateral line and on caudal peduncle; dorsal and anal with a scaly sheath at base; caudal finely scaled; pectoral scaled at base.

Color in alcohol, seal-brown on back and sides, lighter on belly; lateral line dark brown, almost black; membranes of rays of dorsal, caudal, anal, and ventrals, dark brown, rays lighter; pectoral yellowish. Description is based on an individual 35 cm. in length from Paita.

Comparative measurements of an individual 27.7 cm. long from Mollendo: Head 2.59 in length; depth 2.45; eye 3.27 in head; snout 3.54; maxillary 1.89; interorbital 5.5; pectoral 1.5; ventral 1.74; D. X, 11; A. III, 9 ( $\frac{1}{2}$ ).

## Genus EPINEPHELUS Bloch.

## 96. EPINEPHELUS LABRIFORMIS (Jenyns).

## MURIQUE.

*Serranus labriformis* JENYNS, Zool. Beagle, Fish, 1840, p. 8, pl. 3; Galapagos Islands.

*Epinephelus labriformis* JORDAN, Fishes of Sinaloa, Proc. California Acad. Sci., ser. 2, vol. 5, 1895, p. 443.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 1155.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 96.—SNODGRASS and HELLER, Shore Fishes of Galapagos Islands, Proc. Washington Acad. Sci., vol. 5, 1905, p. 367.

Two specimens, field Nos. 09450-1, respectively 22.3 and 21.8 cm. in length, from Lobos de Afuera.

Head 2.54 in length; depth 2.92; eye 5.1 in head; snout 4.38; interorbital 7; maxillary 2.2; D. XI, 16½; A. III, 9; scales 11-105-35.

Body elongate, moderately compressed, arched dorsally; head slender, pointed; upper profile comparatively straight; mouth large, lower jaw strongly projecting; maxillary extending beyond the vertical from the posterior border of eye; preopercle finely serrate; opercle with 3 spines, the middle one long and well developed; scales of medium size, ctenoid, some of those above lateral line, anteriorly, unciliated; third to sixth dorsal spines longest, about 3 in head; caudal rounded; ventrals 2 in head, tips reaching beyond the vent; pectoral rounded, barely reaching tips of ventrals.

Ground color in alcohol, dark brown, almost black; a black saddle on caudal peduncle; fins body-color, narrowly margined with yellowish white; distal half of pectoral brownish; slight traces of lightish spots on the belly.

Measurements of the smaller individual: Head 2.43 in length; depth 2.76; eye 5.46 in head; snout 4.12; interorbital 8.25; maxillary 2.20; D. XI, 16½; A. III, 9.

These individuals are much darker than small examples from Panama and the Galapagos Islands and show very little trace of the light markings so characteristic of specimens from those localities.

## Genus ALPHESTES Bloch and Schneider.

## 97. ALPHESTES MULTIGUTTATUS (Günther).

## COMPANERO DE MERO; MERO.

*Plectropoma multiguttatum* GÜNTHER, Proc. Zool. Soc. London, 1866, p. 600; Panama.

*Plectropoma afrum* GÜNTHER, Fishes Central Amer., Trans. Zool. Soc. London 1860, p. 411, pl. 77, fig. 8.

40856°—Bull. 95—17—6

*Alphestes multiguttatus* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 5, 1882, p. 375.—JORDAN and EIGENMANN, Bull. U. S. Fish Comm., vol. 8, 1888 (1890), p. 349.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 1165.

*Epinepheus multiguttatus* BOULENGER, Cat. Fish. Brit. Mus., vol. 1, 1895, p. 255.

Two specimens, field Nos. 09476 and 09681, 20.6 and 21 cm. in length, from Lobos de Afuera.

Head 2.55 in length; depth 2.72; eye 5.22 in head; snout 4.75; interorbital 8 in head, 1.62 in eye; maxillary 2.3 in head; D. XI, 18 or 19; A. III, 9; scales 18–75–34.

Body strongly compressed, oblong ovate; caudal peduncle rather slender, its depth 3.5 in length of head; head long and pointed, upper profile comparatively straight; lower jaw projecting; villiform bands of teeth on jaws, vomer and palatines, these very slender and elongate; bands in jaws, narrowing posteriorly to one or two rows; several enlarged caninelike teeth in front of jaws on either side of rami of jaws; preopercle finely serrate, with a strong antrorse spine at angle, and six to eight large spines above it on vertical border; three weak, short opercular spines; fourth dorsal spine longest, 2.3 in head, soft rays higher than spines, the longest 2.25 in head; caudal rounded; tips of dorsal and anal rays reaching past base of dorsal; ventrals 2 in head, their tips reaching to vent; pectorals rounded, 1.55 in head.

Ground color in spirits, brownish, with traces of five or six darker cross-bands; numerous dark, round spots on head, body, and vertical fins; vertical fins and ventrals dusky; pectorals yellowish, crossed by five or six wavy bands of brownish.

In these specimens the snout is a little longer than eye, as stated by Günther, and not equal to or shorter than eye, as stated by Boulenger.

### Genus MYCTEROPERCA Gill.

#### 98. MYCTEROPERCA XENARCHA Jordan.

*Mycteroperca xenarcha* JORDAN, Proc. Acad. Nat. Sci. Phila., 1887, p. 387; James Island, Galapagos.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 348.—SNODGRASS and HELLER, Shore Fishes, Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 368.

*Epinepheus xenarchus* BOULENGER, Cat. Fish. Brit. Mus., vol. 1, 1895, p. 266.

Rocky Islands of the eastern Pacific from Mazatlan to the coast of Peru; known from numerous specimens in the Museum of Comparative Zoology at Cambridge, from the Galapagos Islands, and from Payta, Peru. (Jordan and Evermann.)

Genus *EPELYTES*, new genus.

*Type of genus.*—(*Epelytes punctatus*).

Body oblong, moderately compressed; scales moderate or rather small, ciliate, lateral line complete, parallel with the back, tubes straight and extending along the entire scale; mouth rather small, protractile; maxillary without supplemental bone; lips fleshy, thick; jaws with broad bands of villiform teeth and an outer row of round, pointed canines, larger in front than on the sides of the jaws; a small patch of teeth on the vomer; palatines and tongue naked; preopercle weakly denticulate, these barely showing through the fleshy covering of preopercle; opercle with two short, flat spines; gillrakers few; branchiostegals 6; dorsal continuous, base fleshy, the rays XVI, 16; anal III, 13; caudal truncate or rounded; ventrals slightly behind pectorals, close together, spine small; pectorals rounded.

(ἐπῆλυτος = stranger.)

99. *EPELYTES PUNCTATUS*, new species.

NEGRO.

Plate 6, fig. 3.

*Type.*—Cat. No. 77688, U. S. Nat. Mus. (field No. 09706), 40 cm. in length, from Mollendo.

Head 3.10 in length; depth 2.88; eye 6 in head; snout 2.55; maxillary 2.80; interorbital 4; D. XVI, 16; A. III, 13; scales 28–90 (+4)–26.

Body oblong, moderately compressed, rather robust anteriorly; caudal peduncle stout, its least depth 2.12 in head; head deep and heavy; eye small, high, 1.5 in interorbital; lips thick and fleshy; mouth small; posterior border of maxillary not reaching vertical from front of eye; maxillary without supplemental bone; bands of villiform teeth in jaws, with an outer row of large, curved, conical canines, those in front of jaws larger than those on sides; a small patch of villiform teeth on vomer, none on palatines and tongue; preopercle with traces of weak denticulations, largely concealed by integument; gillrakers rather short, 8+16, the longest 2.18 in eye.

Scales above lateral line anteriorly small, becoming larger posteriorly and below lateral line; small, elongate, overlapping nonciliated scales on cheeks and opercles; jaws, and top of head anteriorly, without scales; scales on top of head and behind occiput nonciliated, others ciliated; fins scaly. Origin of dorsal in vertical from posterior border of opercle; first dorsal spine very small, concealed by integument, half as long as second, which in turn is about one-half third, first to sixth spines graduated, sixth to sixteenth of

about equal length, about 5 in head; soft dorsal higher, the longest ray about twice longest spine; caudal truncate; anal spines small, graduated, much shorter than soft rays, fin rounded; ventrals inserted slightly behind base of pectorals, their length 1.86 in head; pectoral rounded, middle rays longest, 1.46 in head.

Color in alcohol, brownish olive, almost black in places; body, dorsals, caudal and anal punctulate with small round, dark brown or black spots; head plain.

In general appearance this species bears a strong resemblance to some of the Labrids.

### Genus CRATINUS Steindachner.

#### 100. CRATINUS AGASSIZII Steindachner.

##### PEJE-ZORRO.

Plate 7, fig. 1.

*Cratinus agassizii* STEINDACHNER, Ichth. Beltr., vol. 7, 1878, p. 19; Galapagos Islands.—JORDAN and EIGENMANN, Rev. Serranidae, Bull. U. S. Fish Com., vol. 3, 1890, p. 394.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 1188.—SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 370.

*Serranus agassizii* BOULENGER, Cat. Fish. Brit. Mus., ed. 2, vol. 1, 1895, p. 281.

One specimen, field No. 09562, 34 cm. in length, from Paita.

Head 2.70 in length; depth 4; eye 6.7 in head; snout 3.12; interorbital (bone) 1.5 in diameter of eye; maxillary 2.64 in head; D. X, 13; A. III, 7; scales, counting downward and backward from origin of dorsal to lateral line 12, in vertical series 8; tranverse series downward and backward above lateral line 65; vertical series 80 (+5); from base of anal upward and forward 26, in vertical series 18; 58 pores in lateral line; scales strongly ctenoid. Gillrakers rather stout, armed with small spinules, the longest 1.72 in eye, 7+13.

Body elongate, rounded; head long and pointed; eye rather small, about 2.2 in snout, which is long and pointed; interorbital concave; lower jaw projecting; maxillary reaching vertical from middle of eye; a villiform band of teeth in upper jaw, with an outer row of enlarged canine-like teeth and three or four enlarged teeth at symphysis inside the band of villiform teeth; teeth of lower jaw unequal; in front of jaws there is an outer row of slightly enlarged teeth; behind the narrow band of villiform teeth is a similar row, on the sides of the jaw the teeth in this row are much enlarged and the band of villiform teeth outside is very narrow; villiform bands of teeth on vomer and palatines; preopercle armed with small sharp, denticulations.

The first and second dorsal spines are short, the third to sixth are long and filamentous, the third is as long as the head, the fourth is two-thirds as long as the third and slightly longer than fifth; the sixth is one-third of the third; caudal slightly emarginate, the upper rays longer than the lower; anal spines weak, much shorter than the rays; ventrals short, their tips reaching half way from base to third anal ray, 2.20 in head; middle ray of pectoral longest, 1.66 in head, fin rather broad.

Color in alcohol, yellowish brown, darker on back; traces of six or seven dusky cross-bands on sides; fins dusky.

### Genus PARALABRAX Girard.

#### KEY TO SPECIES.

- $\alpha^1$ . Dorsal rays 12 or 13; scales 12-77 to 80-25; interorbital 4.40 to 5.00.  
humeralis, p. 73.  
 $\alpha^2$ . Dorsal rays 14; scales 15-90-32; interorbital 6-6.16.....callaensis, p. 74.

#### 101. PARALABRAX HUMERALIS (Cuvier and Valenciennes).

##### CABRILLA; TRAMBOLLO.

*Serranus humeralis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 2, 1828, p. 183 (246); Chile.—GUICHENOT in Gay, Hist. Nat. Chile, Zool., 1854, p. 149.—STEINDACHNER, Herpet.-Ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 24; Callao.

*Serranus semifasciatus* GAY, Hist. Chile, Zool., vol. 2, 1848, p. 151, Atl. Zool. Ictiol., 1854, pl. 1bis., fig. 2.

*Paralabrax humeralis* JORDAN and EIGENMANN, Rev. Serranidae, Bull. U. S. Fish Comm., vol. 8, 1890, p. 389.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 348.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 787.

Two specimens, field Nos. 09142-3, respectively 15.7 and 15.9 cm. long, from Callao, from fish hucksters; one, field No. 09413, 22.8 cm. long, from Guanape North Island; one, field No. 09610, 20.9 cm. long, from Chinchá Island; one, field No. 09626, 27 cm. long, from Independencia Bay, Santa Rosa Island, east side; one, field No. 09524, 33.5 cm. long, from Lobos de Tierra; one, field No. 09123, 20.1 cm. long, from Callao, Lima Market, called "Trambollo;" and one, field No. 09715, 37.5 cm. long, from Mollendo.

Head 2.47 to 2.6 in length; depth 3.3 to 3.5; eye 4.8 to 6 in head; snout 3.4 to 4.4; maxillary 2.3 to 2.65; interorbital 4.4 to 5; D. X, 12 or 13; A. III, 7; scales 12-77 to 80 (+5)-25.

Body elongate, moderately arched; head pointed; lower jaw projecting; maxillary reaching vertical from posterior border of pupil; preopercle serrate; opercular spine stout; scales large, strongly ctenoid; spinous dorsal rather high, third dorsal spine longest, 2.35

to 2.85 in head; caudal truncate or slightly lunate; anal spines rather small; ventrals not reaching vent, 1.78 to 1.92; pectoral 1.4 to 1.55 in head, its base 5.5 to 6.

Color in alcohol, dusky olive-brown; fins dusky, pectorals lighter, yellowish; small round light spots on the top and sides of the head and traces of darker cross-bands on body in the young. In some of the specimens there are traces of mottlings on the fins and body and an indistinct trace of a white spot on back between lateral line and base of caudal.

102. *PARALABRAX CALLAENSIS* Starks.

CASICA; CABRILLA.

*Paralabrax callaensis* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 787, pl. 65, fig. 2; Callao, Peru.

One specimen, field No. 09408, 15.8 cm. in length, from Guanape North Island, and one, field No. 09161, 21.5 cm. in length, from Chimbote, from fishermen.

Following are the comparative measurements of these two individuals, those of the larger specimen appearing first: Head 2.3 and 2.35 in length; depth 3.15 and 3.18; eye 4.94 and 4.5 in head; snout 4 and 3.6; maxillary 2.55 and 2.45; interorbital 6.16 and 6; D. X, 14; A. III, 7; scales 15-90 (+5 or 6)-32.

Body compressed, elongate, rather slender; lower jaw strongly projecting; maxillary barely reaching vertical from posterior border of pupil; preopercle armed with small sharp spinules; gillrakers long and slender, 12+22, the longest 1.67 in eye; interorbital narrow, flat; third dorsal spine longest, much longer than first and second, 2.35 in head; caudal truncate; second anal spine stout, longer than the third, 3.5 in head; ventrals barely reaching to vent, 1.9 in head; pectoral broad, breadth of base 3.6 in the length of the fin, which is 1.55 in head.

Color in alcohol: Brownish olive; back and sides of body with irregular, wavy bands of brownish, these become broken below the lateral line posteriorly and on caudal peduncle into irregular oblong or round spots; sides of head with similar bands, these more distinct and sharply defined; fins dusky, base of pectoral with a brownish area and a light slim circular area across base of rays.

In the smaller individual, the bands on the cheeks are replaced by rows of large round dots on a darker band, approaching the coloration of *humeralis*; on the opercle the bands are apparent. Rivulations on sides of body obscured except on basal half of caudal peduncle and caudal fin. The white spot on back between lateral line and base of dorsal is not well marked in these individuals.

This species differs from *P. humeralis* in coloration and in the size of the scales. In individuals of the same size *P. callaensis* has a longer head and slightly deeper body, a much narrower interorbital and one more ray in the soft dorsal.

Genus DIPLECTRUM Holbrook.

193. DIPLECTRUM CONCEPTIONE (Cuvier and Valenciennes).

CAMOTILLA.

Plate 7, fig. 2.

*Serranus conceptionis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 2, 1828, p. 183 (246); Chile.—BOULENGER, Cat. Fish. Brit. Mus., ed. 2, vol. 1, 1895, p. 296.—DELFIN, Cat. Peces de Chile, 1901, p. 63.

?*Plectropoma paytensis* LESSON, Voy. Coquille, Zool., vol. 2, 1830, p. 233; Païta, Peru.

*Diplectrum conceptione* JORDAN and EGERMANN, Rev. Serranidae, Bull. U. S. Fish Comm., vol. 8, 1890, p. 399.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1890, p. 349.

?*Hemilutjanus paytensis* JORDAN and EIGENMANN, Rev. Serrandiae, Bull. U. S. Fish Comm., vol. 8, 1890, p. 345.

Three specimens, field Nos. 09543, 09547, and 09558, respectively 11.8, 14.2, and 30.1 cm. in length, from Païta. The smaller specimens were taken with a hook and line, a short distance out from the pier. Evidently a very common little fish in this part of the bay. (Coker.)

Two specimens, field Nos. 09529 and 09584, 27.5 and 24.5 cm. in length, from Lobos de Tierra.

Head 2.81 in length; depth 3.67; eye 5.72 in head; snout 3.63; maxillary 2.4; interorbital (bone) 8.42; D. X, 12; A. III, 7; scales 8-60 (+5)-20.

Body compressed; mouth large, oblique; maxillary reaching vertical from middle of eye; lower jaw slightly projecting; eye large, elliptical, high; interorbital slightly concave; snout short and bluntish; preopercle with a well-developed process at angle projecting backward, armed with a series of enlarged denticles; gillrakers elongate, slender, 7+13.

Scales large, ctenoid, those on cheeks in 9 rows; none on top of head and snout; dorsal spines rather slender, fin without distinct notch; caudal nearly truncate, outer rays slightly longer than others; anal spines small, graduated; ventrals short, reaching three-fourths distance to insertion of anal, 1.82 in head; pectorals broad and rounded, 1.45 in head.

Color in life: Back and upper part of sides dark olive green, but with three pale horizontal stripes; one, from just above pectoral to just beneath lateral line on peduncle; a second, from level of eye,

and beginning a short distance posterior to eye, to upper part of peduncle; a third, at a corresponding distance above the second; a darker mottling on the sides gives an indistinct effect of crossbar-ring, especially on upper part of sides; sides, below lowest stripe, dusky, greenish with much gold; below white with a tinge of orange along median line of belly; head above olive with reddish spots, orange on lower part of sides; under side of opercle with jet black and gold; skin posterior to fourth gill blue-black; caudal mostly reddish orange, ventral margin pale; dorsal light olive with large spots of bright orange; a little black on tips of membrane between dorsal spines; pectorals olivaceous; ventrals mixed dusky olive and orange; anal mostly white, but with some orange on membrane between consecutive rays. (The above description is based on a specimen, No. 09529, 27.5 cm. in length, from Lobos de Tierra.)

Comparative measurements of a specimen No. 09558, 30.1 cm. in length, from Paita: head 2.73 in length; depth 3.95; eye 5.36 in head; snout 3.75; maxillary 2.34; interorbital (bone) 9; pectoral 1.43; ventral 1.67; D. X, 12; A. III, 7.

Color in life of field No. 09543, 11.8 cm. long; back and sides olivaceous, mottled with reddish; rather inconspicuous short orange stripe on posterior ends of premaxillary and maxillary, extending posteriorly and ventrally; region of upper teeth yellow; roof of mouth and floor, (posterior to anterior ventral end of first branchial arch) yellow, sometimes with some black on each side above and below; lining of gill cavity black posteriorly; large bright yellow spot on side, forward of anus and just below mid-line; belly yellow in median line, in posterior half; dorsal translucent, but thinly mottled with olivaceous and orange; membrane just posterior to each spine tipped with reddish orange; a minute black speck on membrane just at tip of each spine; soft dorsal tipped with reddish orange; anal almost entirely yellow; caudal and ventrals dusky olivaceous.

### Genus PRIONODES Jenyns.

#### KEY TO SPECIES.

*a*<sup>1</sup>. Anal rays 7.

*b*<sup>1</sup>. Eye 5.5 in head, shorter than snout; interorbital 6.4; depth of body 3.15; distal half of soft dorsal and outer caudal rays with numerous small jet black spots; caudal, anal, and ventrals mottled-----*fasciatus*, p. 77.

*b*<sup>2</sup>. Eye 4 in head, equal in length to snout; interorbital 8; depth of body 4; fins without spots or stripes-----*huascarii*, p. 78.

*a*<sup>2</sup>. Anal rays 9; reddish brown with a pale stripe along lateral line; head, body, and sides silvery, with seven or eight large, round spots; dorsal yellowish, edged with red; caudal brownish; anal reddish brown with two rounded reddish-brown spots-----*peruanus*, p. 78.

## 104. PRIONODES FASCIATUS Jenyns.

## CARAJO; CARAJITO.

*Prionodes fasciatus* JENYNS, Zool., Voy. *Beagle*, p. 47, 1842, pl. 9, fig. 1; Chatham Island, Galapagos.—JORDAN, Fishes of Sinaloa, Proc. California Acad. Sci., ser. 2, vol. 5, 1895, p. 452.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 1212.—GILBERT and STARKS, Fishes Panama Bay, Mem. Cal. Acad. Sci., vol. 4, 1904, p. 98.

*Serranus psittacinus* VALENCIENNES, Voy. *Vénus*, Poiss., 1855, p. 299, pl. 1, fig. 1.—BOULENGER, Cat. Fish. Brit. Mus., ed. 2, 1895, p. 295.

Two specimens, field Nos. 09682 and 09459, respectively 18.5 and 12.6 cm. in length, from Lobos de Afuera.

Head 2.65 in length; depth 3.15; eye 5.5 in head; snout 3.6; maxillary 2.25; interorbital (bone) 6.4; D. X, 12; A. III, 7; scales 5-48(+5)-15.

Body rather short, compressed, oblong oval; snout pointed, lower jaw projecting; maxillary reaching vertical from middle of orbit; eye moderate, 1.5 in snout; interorbital flattish; a band of villiform teeth in upper jaw, with an outer series of enlarged caninelike teeth, those in front largest, at the symphysis behind the villiform teeth are several similar teeth; two enlarged caninelike teeth in front of lower jaw, behind these a band of villiform teeth, followed by an inner series of enlarged caninelike teeth, which become larger posteriorly, the villiform band narrowing to one or two series; well developed teeth on vomer and palatines; preopercle finely serrate; gillrakers short, 5+9. Scales rather large, strongly ctenoid, those on cheeks small, in about 10 rows; top of head, sides posteriorly to middle of eye, and maxillaries naked.

Dorsal low, fourth spine longest, 3.3 in head; caudal slightly emarginate; tips of soft dorsal and anal rays reaching base of caudal, second anal spine longest, as long as fourth dorsal spine; ventrals inserted in front of pectorals, 1.64 in head; middle rays of pectoral longest, 1.38 in head.

Color in life: Two rows of spots on the sides; the spots of the same row may tend to run together, or the spots of one row may be more or less fused with corresponding spots in the other row; hence some specimens present a sort of transversely barred effect, while others are indistinctly striped.

Much red and orange about lower parts of head. Rows of red spots between the fin rays of the caudal and on the rays of the pectoral.

Ground color in alcohol, olivaceous, sides with about 10 dark cross-bands, these disappearing below lateral line and reappearing on level with base of pectoral fin; some scales below base of pectoral, in

front of base of ventrals and on breast, with irregular black areas; head dusky, with trace of black band behind eye; distal half of soft dorsal and outer caudal rays with numerous small jet-black spots; caudal, anal and ventrals with peculiar mottlings; these usually in the form of small ellipses, the outline dusky, margined inside and out with white and usually with a dusky central spot as shown in Jenyns' figure.

105. *PRIONODES HUASCARII* (Steindachner).

*Serranus huascarii* STEINDACHNER, Herpet.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 24, pl. 2, fig. 1; Paíta, Peru.

106. *PRIONODES PERUANUS* (Lesson).

*Serranus peruanus* LESSON, Voy. Coquille, vol. 2, pt. 1, 1828, p. 234; Paíta.—JORDAN and EIGENMANN, Rev. Serranidae, Bull. U. S. Fish. Comm., vol. 8, 1888, p. 408 (1890).

From the scant description of this species it is impossible to identify it certainly with any known Serranid from the coast of Peru and we have provisionally placed it here on account of the number of dorsal rays.

Genus *PARANTHIAS* Guichenot.

107. *PARANTHIAS FURCIFER* (Cuvier and Valenciennes).

CABINSA.

*Serranus furcifer* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 2, 1828, p. 196 (264); Brazil.

*Paranthias furcifer* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 1222.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 98.—SNODGRASS and HELLER, Shore Fishes of the Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 372.

One specimen, field No. 09488, 18.8 cm. in length, from Lobos de Afuera.

Head 3.2 in length; depth 2.8; eye 4.53 in head; snout 4.3; maxillary 2.53; interorbital 4.3; D. IX, 19; A. III, 10; scales 12–118–38.

Body slender, strongly compressed, oblong ovate; caudal peduncle 2.6 in head; snout short, maxillary reaching to vertical from middle of eye; narrow bands of villiform teeth on jaws, vomer, and palatines, several caninelike teeth in front of jaws; preopercle finely serrate; gillrakers long and slender, 12–25, the longest 1.9 in eye; scales small, strongly ctenoid; dorsal and anal low, caudal deeply forked; ventrals reaching vent, 1.85 in head; pectoral reaching to or behind tips of ventrals, 1 in head.

Color in life: Back and sides dark olive green, lighter on lower part of sides; ventral part of head, body, and peduncle a thin scarlet,

deeper in places; small spots (about one-half diameter of pupil) irregularly disposed over posterior part of body; most of these spots white, some green; a green spot of same size on the flap just above insertion of pectoral; dorsal tipped with reddish; anal reddish, especially toward tip; caudal narrowly margined all around with reddish; ventral reddish, the exterior margin, including the spine, blue; a very pleasing fish in form and color.

According to fishermen from Pimentel the name of this fish is "Cabinsa," the name applied to this red fish in its northern range, while the gray fish (*Isacia conceptionis*), which bears this name in the south is here called "Chibelico."

•  
**Genus HEMIANTHIAS Steindachner.**

**108. HEMIANTHIAS PERUANUS (Steindachner).**

**DONCELLA.**

Plate 7, fig. 3.

*Anthias (Hemianthias) peruanus* STEINDACHNER, Ichth. Beltr., vol. 1, 1874, p. 4; Paita; Trujillo.

*Hemianthus peruanus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 1, 1896, p. 1222.

*Pronotogrammus peruanus* JORDAN and EIGENMANN, Rev. Serranidae, Bull. U. S. Fish Comm., vol. 8, 1890, p. 413.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 350.

• *Anthias peruanus* DELFIN, Cat. Peces de Chile, 1901, p. 65.

One specimen, field No. 09548, 34.5 cm. in length, from Paita.

Head 2.84 in length; depth 2.95; eye 4.5 in head; snout 4; maxillary 2.53; interorbital 5.4; D. X, 14; A. III, 8; scales 10-55 (+4)-20.

Body compressed, rather deep; caudal peduncle rather stout, its least depth 2.45 in head; mouth very oblique; lower jaw strongly projecting, its upper edge entering into upper profile of head; upper profile of head concave; eye very large, its diameter nearly equal to the length of the snout; maxillary reaching vertical from anterior border of pupil; an outer row of enlarged conical, recurved teeth in upper jaw, back of these a narrow band of villiform teeth, back of this several enlarged caninelike teeth on either side of symphysis; front of lower jaw with 2 large recurved canines, smaller teeth back of these, those on sides of jaw reduced to a single series; vomerine teeth present; a small patch of teeth on the palatines. Gillrakers long and slender, 10+24, the longest 1.37 in eye; vertical border of preopercle slightly concave, finely denticulate, those at angle enlarged, projecting backward in a horny process, denticulations on lower border enlarged.

Dorsal spines slender, the third filamentous, longer than head, 2.5 in length; soft dorsal high, the posterior rays longest, reaching past

base of caudal, twelfth and thirteenth rays longest, 1.7 in head; caudal elongate, filamentous, the middle rays longest, longer than head, 2.20 in length; anal similar to soft dorsal, third anal spine longest, 3 in head; last ray longest, 1.3 in head; ventrals filamentous, reaching to base of soft rays of anal, 2.77 in length of body; pectorals short, middle rays longest, 1.4 in head; scales moderate, somewhat deciduous; top of head, maxillary and preorbital scaleless.

Color in alcohol, yellowish, probably red in life; small brown spots on body above lateral line; a similar row on membranes between rays of soft dorsal; a similar row on caudal rays where these divide, in some cases there are two rows, one following each main division; similar rows on membranes between posterior anal rays.

### Family HAEMULIDAE.

#### THE GRUNTS.

##### KEY TO GENERA.

- $\alpha^1$ . Chin with a central groove behind the symphysis of the lower jaw.
  - $b^1$ . Soft dorsal and anal usually with fine scales on the basal part of the membranes.
    - $c^1$ . Body ovate, the back elevated; depth greater than length of head; outer teeth of upper jaw enlarged; lips thick; second anal spine very strong, longer and stronger than the third.....*Anisotremus*, p. 80.
    - $c^2$ . Body oblong, the depth usually less than length of head; lips not very thick; scales large, those above lateral line in series mostly parallel with lateral line.
      - $d^1$ . Preopercle very sharply serrate, the serrae at angle much enlarged, those below angle turned forward; outer teeth in both jaws considerably enlarged; second anal spine enlarged....*Conodon*, p. 82.
      - $d^2$ . Preopercle finely serrate, the serrae at angle scarcely enlarged, those below not antrorse; teeth subequal or the outer in upper jaw somewhat enlarged; gillrakers very short and weak; anal spines small or moderate; the second little if any longer or stronger than the third; body oblong, not elevated; scales above the lateral line parallel with the back.....*Brachydeuterus*, p. 83.
  - $b^2$ . Soft parts of dorsal and anal without scales.
    - $e^1$ . Anal spines strong, the second much longer and stronger than the third.....*Pomadasis*, p. 85.
    - $e^2$ . Anal spines small, the second shorter or equal in length to the third.....*Orthopristis*, p. 87.
- $\alpha^2$ . Chin with pores but with no central groove at the symphysis; soft rays of dorsal and anal naked or partly scaled; anal fin long, with 10 or 13 rays.....*Isacia*, p. 89.

### Genus ANISOTREMUS Gill.

##### KEY TO SPECIES.

- $\alpha^1$ . D. XI, 14; A. III, 10; scales in lateral line 46 to 48.....*pacifict*, p. 81.
- $\alpha^2$ . D. XII, 15-17; A. III, 13; scales in lateral line 58 to 62. ....*scapularis*, p. 81.

109. *ANISOTREMUS PACIFICI* (Günther).

- Conodon pacifici* GÜNTHER, Proc. Zool. Soc. London, 1864, p. 147; Chiapas.  
*Anisotremus pacifici* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1316.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 106.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 788; Guayaquil.  
*Anisotremus* (*Paraconodon*) *pacifici* STEINDACHER, Herpet.-Ichthoysl., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 27.

Pacific coast of Central America; southward to Peru; common at Panama.

110. *ANISOTREMUS SCAPULARIS* (Tschudi).

CHITA; SARGO; CORCOVADO.

Plate 8, fig. 1.

- Pristopomus scapulare* TSCHUDI, Fauna Peruana, Ichth., 1844, p. 12; Huacho.  
*Anisotremus scapularis* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1320.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 350.—SNODGRASS and HELLER, Shore Fishes of Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1906, p. 377.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 788.

One specimen, field No. 09709, 40 cm. long, locally called "sargo," from Mollendo. One specimen, field No. 09574, 23.5 cm. long, from Callao; one specimen, field No. 425, 13.6 cm. long, from near San Lorenzo Island, Callao; one specimen, field No. 476, 22 cm. long from Ballestas Island, region of Pisco, taken with a trammel net in 1 to 3 fathoms; two specimens, field Nos. 09467 and 09470, respectively 23 and 23.5 cm. long, from Lobos de Afuera; one specimen, field No. 09506, 4.8 cm. long, from Lobos de Tierra; and one specimen, field No. 09559, 27 cm. long, locally known as "Corcovado," from Paita.

Head 3 to 3.3 in length; depth 2.1 to 2.45; eye 3.8 to 5.35; snout 2.85 to 3.4; interorbital 2.5 to 3.1; pectoral 1 to 1.1; D. XII, 15-17; A. III, 13; scales 11-58 to 62-20(+3).

An example 40 cm. long from Mollendo had head 3.23 in length; depth 2.4; eye 5.1 in head; snout 3.1; maxillary 3.18; interorbital 2.68; pectoral 1.13; D. XII, 17; A. III, 13; scales 11-60-22.

Body stout, the dorsal outline strongly arched, ventral outline straighter; caudal peduncle rather small, its depth 2.4 in head; head short, profile very steep; snout short and blunt; mouth small, horizontal; maxillary reaching to the vertical from the anterior border

of the eye; teeth in jaws in broad bands, with an outer row of enlarged teeth; vertical border of preopercle very finely serrate; fourth dorsal spine longest, 2.55 in head; caudal forked; second anal spine longest and strongest, 3.3 in head; ventrals moderate, their tips reaching midway from their base to origin of anal rays; pectorals long, falcate, their tips reaching vertical from base of last dorsal spine.

Spinous dorsal fitting into a groove; soft dorsal with a scaly sheath at base; caudal scaled; base of anal with a wide sheath of small scales, smaller scales on membranes; a scaly area at base of pectoral, finer scales reaching out on membranes to near tip of fin; head in front of eye without scales.

Color in alcohol: Dusky gray on back, becoming silvery yellow on belly; fins blackish; opercular margin black; axil and base of pectoral black; axils of ventrals black; a black area on posterior base of soft dorsal and anal.

Color in life: Silver-gray, slightly olivaceous above; fins dark; opercle margined with black; axil of pectoral black; a black bar crossing base of pectoral externally; a black spot at posterior base of dorsal on back and fin, the spots of the two sides being confluent; similar spots confluent around posterior margin of anal.

Doctor Coker writes that this fish is excellent in quality of meat and elegant in appearance. Silver-gray in color, neatly trimmed with black.

A small alcoholic specimen from Lobos de Afuera has the following coloration: Back and sides dusky reddish brown, becoming lighter ventrally; spinous dorsal dusky, soft dorsal blackish distally, with a light area at base of rays; caudal dusky; anterior two-thirds of anal black; a black area on distal third of ventrals; pectorals dusky.

Coasts of Peru, Galapagos Islands, and Cocos Island.

#### Genus CONODON Cuvier and Valenciennes.

##### 111. CONODON SERRIFER Jordan and Gilbert.

##### OJO DE UVA.

##### Plate 8, fig. 2.

*Conodon plumieri* STREETS, Bull. U. S. Nat. Mus., vol. 7, 1877, p. 50; Boca Soledad, west coast of Lower California; not Cuvier and Valenciennes.

*Conodon serrifer* JORDAN and GILBERT, Proc. U. S. Nat. Mus., 1882, p. 351; Boca Soledad, Lower California.—JORDAN and EVERMANN, Fish. North and Mid. Amer., vol. 2, 1898, p. 1324.

One example, field No. 331, 26.5 cm. long, from Capon, region of Tumbes.

Head 8.15 in length; depth 3.3; eye 3.75 in head; snout 3.75; maxillary 2.76; interorbital 3.75; pectoral 1.13; D. XI, I, 12; A. III, 7; scales 7-50 (+3)-15.

Body rather elongate, fusiform, little compressed; curvature of dorsal and ventral outlines nearly equal. Head short, broad, interorbital broad and flat, outline from tip of snout to base of dorsal nearly straight; eye very large, equal to snout and interorbital; mouth large, oblique, lower jaw projecting; maxillary reaching to vertical from anterior border of pupil; villiform bands of teeth on jaws, an outer row of enlarged blunt, canine-like teeth in each jaw; preorbital narrow, equal to diameter of pupil; vertical border of preopercle concave, angle acute, ending in a long spine, projecting backward and upward; free margin everywhere armed with strong denticulations; gillrakers slender.

Spinous dorsal triangular, fourth spine longest, 2 in head; soft dorsal low; caudal truncate; second anal spine very long and strong, longer than third; anal spine and rays 2.25 in head; ventrals moderate, tips reaching half-way from base to first soft ray of anal, 1.5 in head; pectoral nearly as long as head, slightly falcate; base of pectoral below level of eye; scales moderate, regular in arrangement, the rows of scales above lateral line parallel with it.

Color in alcohol, brown; silvery reflections on belly, traces of about seven blackish bars on sides.

This individual agrees in all essential characters with the types, U. S. Nat. Mus. No. 17546, of this species. The coloration is much darker and the outer row of teeth larger than in the types, similar to *Conodon nobilis*. This species has been previously recorded only from Lower California.

### Genus BRACHYDEUTERUS GILL.

#### BURRITOS.

#### KEY TO SPECIES.

*a*<sup>1</sup>. Preorbital narrow, narrower than eye; snout short, 3 in head—*nitidus*, p. 83.

*a*<sup>2</sup>. Preorbital broad, wider than eye; snout long, pointed, 2.4 in head.

*leuciscus*, p. 84.

#### 112. BRACHYDEUTERUS NITIDUS (Steindachner).

#### GALLINAZO.

*Pristipoma (Haemulopsis) nitidum* STEINDACHNER, Ichth. Notizen, vol. 8, 1869, p. 5, pl. 3, Mazatlan, Mexico.

*Pomadasis nitidus* JORDAN, Fishes of Sinaloa, Proc. California Acad. Sci., ser. 2, vol. 5, 1895, p. 462.

*Brachydeuterus nitidus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1326.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 109.

Two specimens, field No. 1039, 16.5 and 17.1 cm. long, from Capon (Tumbes).

Head 2.93 in length; depth 2.8 to 2.87; eye 3.52 to 3.91 in head; snout 3.15; maxillary 3.35 to 3.4; interorbital 4 to 4.27; pectoral 1.08 to 1.14; third dorsal spine longest, 1.88 to 2.07; D. XII, 13 to 15; A. III, 8; scales 6 or 7-53 (+2)-11.

Body stout, compressed, back strongly arched; ventral outline less strongly curved than back; head moderate, pointed; mouth small, oblique, maxillary scarcely reaching vertical from front of eye; preorbital two-thirds diameter of eye; eye large, nearly as long as snout, wider than interorbital; preopercle finely serrated; gillrakers long and very slender, 6+13. First dorsal spine very small, third longest; fin not notched; caudal forked; anal spines weak, slender, third longest; ventrals moderate, shorter than pectorals; pectoral nearly as long as head, tip reaching to base of first dorsal ray.

Color in alcohol: Dark silvery brown; centers of scales dusky black, forming lines along the rows of scales, these lines most distinct below lateral line; a large blackish blotch on shoulder at origin of lateral line; opercle blackish; fins brown.

Gilbert and Starks give the following measurements for four specimens from Panama:

Head 3 to 3.25 in length; snout 3 to 3.25 in head; eye 4 to 4.2; interorbital (bone) 5; scales 48 to 50; dorsal rays 14 or 15; anal rays 8 or 9; upper caudal lobe conspicuously longer than lower lobe.

Gulf of California to Mazatlan, Panama, and southward to Peru.

### 113. BRACHYDEUTERUS LEUCISCUS (Günther).

#### RONCADOR; RONCADOR DE AGUA DOLCE.

*Pristipoma leuciscus* GÜNTHER, Proc. Zool. Soc. London, 1864, p. 147; San Jose de Nicaragua, Chiapas.

*Pristipoma leuciscus* var. *elongatus* STEINDACHNER, Neue und Seltene Fisch-Arten, Denkschr. Akad. Wiss. Wien, vol. 41, 1879, pp. 30, 52, pl. 9, fig. 2; Tumbes.

*Brachydeuterus leuciscus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1327.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 109.

*Pomadour leuciscus* REGAN, Biologia Centrali-Americana, Fishes, p. 42, 1906 (1906-1908).

One specimen, field No. 1012, 21.5 cm. long, from mouth of Tumbes River, Tumbes, taken with a casting net.

Two specimens, field No. 1028, 12.2 and 13.2 cm. long, from Capon (Tumbes).

Head 2.69 in length; depth 2.96; eye 4.64 in head; snout 2.42; maxillary 3.51; interorbital 4.48; pectoral 1.35; preorbital wider than eye, 4.33; third dorsal spine longest, 2.09; second anal spine longest, 3.82; D. XII, 15; A. III, 8; scales 7-51 (+)-13.

Body moderately elongate, slender, compressed, dorsal outline strongly arched; ventral outline nearly straight; head pointed; snout

long, nearly twice as long as horizontal diameter of eye; interorbital broad, flat or slightly concave; mouth small, lower jaw included; maxillary not reaching ventral from anterior border of eye by a distance equal to pupil; teeth villiform, in broad bands, outer row on upper jaw slightly enlarged; preorbital wider than eye; preopercle strongly and evenly serrate; dorsal spines long, slender, the third longest, the last considerably longer than the one before it; soft dorsal low and evenly arched; caudal lunate; second anal spine a little longer and stronger than the third; ventrals reaching to within two-thirds diameter of eye of vent; pectorals short, their tips reaching to below last dorsal spine; upper caudal lobe longer; scales strongly ctenoid; lateral line strongly arched, parallel with contour of back, becoming straight under posterior third of anal; scales above lateral line parallel with it, regular in their arrangement; preorbital scaled; subopercle scaled; top of snout naked.

Color in alcohol: Silvery brown; a broad silvery lateral stripe, the centers of the scales in this stripe dusky black, forming dark horizontal lines along the rows of scales, these replaced by silvery lines below; a blackish shoulder blotch as in *nitidus* and a dark area on opercle; fins brownish. Description based on a specimen 21.5 cm. long from Tumbes.

The smaller specimens have D. XI, 15 and XII, 14, and are much slenderer in form.

This species ranges from Lower California to Peru; very abundant at Panama.

#### Genus POMADASIS Lacépède.

##### THE BURROS.

##### KEY TO SPECIES.

- $\alpha^1$ . Dorsal spines XI or XII; preorbital broad; preopercle serrate; fourth dorsal spine longest 1.9 to 2.25 in head; eye 4 to 4.62 in head.....*schyri*, p. 85.  
 $\alpha^2$ . Dorsal spines XIII; preorbital narrow; eye large, 3 to 3.5 in head; fourth dorsal spine longest, 1.5 to 1.66 in head.....*branicki*, p. 86.

#### 114. POMADASIS SCHYRI Steindachner.

##### RONCADOR.

*Pomadasys schyri* STEINDACHNER, Herpt.-Ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 27, pl. 4, fig. 1; Guayaquil.

One specimen, field No. 1005, 22 cm. long from Tumbes, taken with a casting net at the mouth of the Tumbes River.

Head 2.51 in length; depth 2.62; eye 4.62 in head; snout 3.08; interorbital 4.1 (5.7 bone); maxillary 3.26; pectoral 1.15; D. XII, 13 ( $\frac{1}{2}$ );

40656°—Bull. 95—17—7

A. III, 8; scales 7-44 (+3)-15; first dorsal spine 8.71 in head, second 5.58, third 2.31, fourth 2.06; second anal spine 1.94, third 3.08; ventrals 1.72; gillrakers 6+15, rather short, longest 3.8 in eye.

Body ovate, compressed, dorsal outline strongly arched, ventral outline comparatively straight to base of anal. Snout long, pointed, conical; a slight depression over eyes; interorbital broad and flat; mouth small, nearly horizontal, maxillary scarcely reaching vertical from anterior border of eye; teeth in narrow villiform bands; nostrils much nearer eye than tip of snout, the anterior nostril with a large flap, partly covering posterior nostril; preorbital broad, slightly wider than eye; margin of preopercle finely and evenly serrate. First dorsal spine short, slightly more than 1.5 in the second; second about 2.46 in third, which is a little shorter than the fourth; eleventh dorsal spine 1.5 in the twelfth, the latter is considerably shorter than the longest rays; the second anal spine is very long, longer than the soft rays, broad at base and tapering to a point, third anal spine shorter and much weaker; ventrals reaching to within half a diameter of eye from vent; ventral spine strong; pectoral long, tip reaching to vertical from base of second dorsal ray; spinous dorsal fitting into a well-developed sheath of scales, a narrow sheath at base of second dorsal; the sheath at base of anal half as wide as eye.

Color in alcohol, brownish, with traces of silvery; fins dusky.

We have provisionally identified this example as *P. schyri*. From *P. macracanthus*, which it closely resembles, it differs mainly in having a narrower interorbital; and from *P. burro* it differs in having well-developed serrations on the edge of the preopercle; its dorsal spines are longer and the eye is smaller. The type of *P. burro* appears to be an old individual and its dorsal and anal spines are grooved and much worn at the tips. *P. andrei* (Sauvage) from the Guayas River near Guayaquil, Ecuador, is evidently a very closely related form.

#### 115. POMADASIS BRANICKI (Steindachner).

##### ECUADOR.

*Pristipoma branicki* STEINDACHNER, Denkschr. Akad. Wiss. Wien, vol. 12 1879, p. 28; Tumbes, Peru.

*Pomadasis branicki* JORDAN and FESLER, Review Sparoid Fishes America and Europe, Rept. U. S. Fish Comm., 1889-91, p. 493 (1893).—JORDAN, Fishes of Sinaloa, Proc. California Acad. Sci., ser. 2, vol. 5, 1895, p. 462.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1333.—GILBERT and STARKS, Fishes Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 110.—REGAN, Biologia Centrali-Americana, 1906, p. 43 (1906-1908).

One specimen, field No. 1028 (part), 17.7 cm. long, from Capon (Tumbes).

Head 2.77 in length; depth 2.94; eye 3.53 in head; snout 2.79; maxillary 3.53; interorbital 4.07; pectoral 1.18; fourth dorsal spine longest, 1.66; second anal spine 1.66; D. XIII, 12; A. III, 7½; scales 7-44 (+4)-13.

Body elongate, compressed, greatest depth under second dorsal spine; anterior outline of head strongly convex; interorbital broad and flat; snout blunt; mouth small, horizontal; maxillary scarcely reaching vertical from anterior border of eye; preorbital 1.5 in eye; vertical margin of preopercle strongly and coarsely serrate; teeth in narrow villiform bands, broadest anteriorly; scapula serrate; gill-rakers slender, 4+11; dorsal and anal each fitting into a narrow scaly sheath. Fourth dorsal spine longest, equal to second anal spine, which is considerably longer than the third; ventrals reaching within one-half diameter of pupil of vent; pectoral longer, reaching to vertical from center of vent.

Color in alcohol, silvery brown.

This well-marked species is easily recognized by the tumid appearance of the snout; the broad, flat, interorbital; the arched profile from the nape to second or third dorsal spine; and the large eye. It occurs on the Pacific coast of tropical America from Mazatlan to Peru.

### Genus ORTHOPRISTIS Girard.

#### THE FIGFISHES.

##### KEY TO SPECIES.

1. Eye 1.75 to 1.9 in snout; origin of dorsal over origin of pectoral; A. III, 11 or 12-----*chalcus*, p. 87.  
 2. Eye equal to snout; origin of dorsal somewhat behind origin of pectoral; A. III, 13-----*modestus*, p. 88.

#### 116. ORTHOPRISTIS CHALCEUS (Günther).

##### CORCOVADO.

*Pristipoma chalcum* GÜNTHER, Proc. Zool. Soc. London, 1864, p. 146; Panama.

*Orthopristis chalcus* EVERMANN and JENKINS, Proc. U. S. Nat. Mus., vol. 14, 1891, p. 149; Guaymas.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1337.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 110.

One specimen, field No. 09724, 35.8 cm. long, from Lobos de Afuera.

Head 2 in length; depth 2.76; eye 5 in head; snout 2.74; maxillary 3.4; preorbital 4.8; interorbital 3.65; pectoral 1.25; D. XI, 16 (½); A. III, 11 (½); scales 12-54 (+)-19; gillrakers, 7+12.

Body ovate, compressed, very deep anteriorly; profile from tip of snout to origin of dorsal nearly straight; snout a little convex, interorbital with a slight concavity and region of nape again slightly convex; greatest height of head nearly equaling its length; eye small, 1.82 in snout, placed close to dorsal profile of head, its horizontal diameter narrower than interorbital and nearly as wide as preorbital; nostrils nearer eye than tip of snout, the anterior elongate, provided with small flap; mouth small, nearly horizontal; maxillary not reaching vertical from anterior border of eye by a distance equal to half diameter of pupil; teeth small, in villiform bands, the outer row in upper jaw a little enlarged; preopercle evenly and finely serrate, the serrae barely showing through the integument. First dorsal spine small, half as long as second, which is 1.5 in third; third nearly equal to fourth, which is longest; dorsal not notched, soft dorsal low; caudal forked, upper lobe longer than lower; second and third anal spines of about equal length, equal to diameter of eye, the second stouter than the third; ventrals reaching to within one diameter of pupil of vent; pectoral nearly reaching vertical from anterior border of vent; base of pectoral under origin of dorsal.

Color shortly after death, dusky silvery with irregular gold stripes, oblique above the lateral line, horizontal below; under side of opercle reddish orange. In alcohol the golden lines along the rows of scales are scarcely discernible; opercular margin dark; general color dusky grayish olive; dorsal and anal dark.

This individual does not differ from examples in the United States National Museum and in the Bureau's reserve series from Guaymas and Panama. The convexity of the snout is more pronounced in the young. Gilbert and Starks in their *Fishes of Panama Bay* state that the maxillary extends beyond the front of the eye. In none of the specimens examined by us does the maxillary extend beyond the vertical from anterior border of the eye and in large specimens it falls considerably short of reaching the vertical. In other respects our specimen agrees very well with their description of this species.

117. *ORTHOPRISTIS MODESTUS* (Tschudi).

*Haemulon modestum* TSCHUDI, Fauna Peruana, Fishes, 1845, p. 11; Peru.

*Orthopristis cantharinus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 351.

Certain discrepancies in the scant description of this species make it impossible to identify it with any known species. By many it has been considered synonymous with *O. cantharinus* Jenyns, but from the description it seems to us more closely related to *O. chalcus*.

## Genus ISACIA Jordan and Fesler.

## 118. ISACIA CONCEPTIONIS (Cuvier and Valenciennes).

## CABINSA.

*Pristipoma conceptionis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 5, 1830, p. 200 (268); Conception de Chile.

*Isacia conceptionis* JORDAN and FESLER, Rep. U. S. Fish Comm., 1888-91, p. 501 (1893).—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 350.—STEINDACHNER, Herpet.-Ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 28.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 789, fig. 9.

*Isacia venusta* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 789, fig. 10; Callao, Peru.

One specimen, field No. 09625, 25.5 cm. long, from east side Santa Rosa Island, Independencia Bay; one specimen, field No. 503, 29.5 cm. long, from Mollendo; two specimens, field Nos. 09419-20, each 24 cm. long, from Guanape North Island; one specimen, field No. 479, 24 cm. long, from Chincha North Island, region of Pisco, taken abundantly in trammel net; four specimens, field Nos. 09134, 09139-41, respectively 17.7, 16.2, 17, and 15.8 cm. long, from Lina Market, Callao; twelve specimens, field No. 09455, 5.8 to 6.3 cm. long; and two specimens, field No. 09448 (part) each 4 cm. long, from Lobos de Afuera.

A study of these specimens and comparison of them with one of the cotypes of *I. venusta* Starks, seem to indicate that the two species, *I. conceptionis* and *I. venusta*, are one. The larger specimens have the smaller eye and the length of the head and depth nearly equal, the head a little the longer of the two; the lower jaw projects more strongly in some specimens than in others and more strongly in the young than in the adult. The relative straightness of the vertical border of the preopercle is variable, in some it is practically straight, in others it is concave, with a long even curve; in still others it is notched near the base.

The table of comparative measurements on the following page will indicate the variability of the species.

Body compressed, dorsal and ventral outline equal and evenly arched; head conical, snout pointed; jaws subequal in the adult, usually the lower a little longer; in the young the projection of the lower jaw is more marked; mouth oblique; maxillary scarcely reaching to the vertical from anterior border of eye; teeth in broad villiform bands, narrowing posteriorly; teeth in the outer row slightly enlarged; vomer and palate without teeth; vertical limb of the preopercle variable from straight to concave or notched; margin dentate, the teeth at angle with wider interspaces; gillrakers long and slender 8+20 to 23; the longest 1.75 in eye.

Scales strongly ctenoid; portion of head in front of eyes naked; soft dorsal naked or with few scales; both dorsals and anal fitting into a groove; caudal scaled; anal with scales on membranes for a short distance; ventrals scaly; pectoral with a scaly area at base.

Dorsals low, third dorsal spine longest, 2.65 in head, anterior rays of soft dorsal longest; caudal forked; anal low, the spines rather

	Mollendo.	Santa Rosa Island.	Guanape North Island.	Guanape North Island.	Chircha North Island.	Callao.	Callao.
Total length.....	29.5	25.5	24	24	24	17.7	16.2
Head in length.....	3.1	2.87	3	3	3.2	2.96	2.98
Depth in length.....	3.12	3.04	3.25	3.25	3.2	3.23	3.19
Eye in head.....	5.43	4.9	4.6	4.6	4.75	4	4.28
Snout in head.....	3.28	3.65	3.47	3.88	3.44	3.68	3.34
Interorbital in head.....	3.28	3.65	3.38	3.67	3.54	4	3.66
Maxillary in head.....	3.41	3.65	3.61	3.67	3.54	3.68	3.6
Pectoral in head.....	1.34	1.1	1.12	1.12	1.07	1.01	1.25
Ventrals in head.....	1.78	1.82	1.78	1.78	1.78	1.6	1.87
Dorsal.....	XIII, 14	XIII, 14	XIII, 14	XIII, 14	XIII, 15	XIII, 15	XIII, 14
Anal.....	III, 13	III, 13	III, 13	III, 13	III, 12	III, 12	III, 13
Pores.....	54	55	55	53	53	54	54
Scales.....	15-56-17	15-56-17	15-56-17	14-56-17	14-56-17	Nearly straight,	Nearly straight.
Vertical border of preopercle.....	Nearly straight.	Slightly concave.	Very slightly concave.	Strongly concave.	Nearly straight.	slight notch near bottom.	

weak; ventrals moderate; pectoral long and falcate, usually reaching to below origin of soft dorsal.

Color in alcohol, dusky olive, with silvery or yellowish tints on belly and lower part of sides; centers of scales dark, these forming horizontal lines, most distinct ventrally; fins dusky, ventrals blackish; pectoral black in axil on upper base.

Color in life of a specimen from Guanape, sides showing various metallic tints when freshly taken; rather dark above lateral line, nine or more rather indistinct stripes below lateral line.

Field No. 04420 from Guanape is abnormal in that it has no ventral fins. There is no trace of them, indicating that it lacked them at birth.

The young vary some in form and coloration.

A specimen 6 cm. long has head 2.8 in length; depth 3.33; eye 3.75 in head; snout 3.6; maxillary 3.6; interorbital 4.5; pectoral 1.5; D. XIII, 14; A. III, 13; pores 54.

Color in life of small specimens from Lobos de Afuera, dusky olive above, white below; two black stripes on side, the first from upper edge of eye along side of body, the second from middle of eye to base of caudal.

Individuals 4 cm. long have a similar coloration and an elliptical black area at base of caudal.

## Family SPARIDAE.

## THE FORGIES.

## Genus CALAMUS Swainson.

## 119. CALAMUS TAURINUS (Jenyns).

*Chrysophrys taurina* JENYNS, Zool., Voy. *Beagle*, Fishes, 1842, p. 56, pl. 12; Galapagos Islands.

*Chrysophrys cyanoptera* VALENCIENNES, Voy. *Vénus*, vol. 5, 1846, pl. 4, fig. 2; Charles Island.

*Calamus taurinus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1354; Payta, Peru.—SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 379.

## Family GERRIDAE.

## THE MOJARRAS.

## KEY TO GENERA.

$\alpha^1$ . Preopercle entire; second anal spine moderate.....*Xystaema*, p. 91.

$\alpha^2$ . Preopercle serrate; second anal spine much enlarged.....*Gerres*, p. 92.

## Genus XYSTAEMA Jordan and Evermann.

## 120. XYSTAEMA SIMILLIMUM (Regan).

## CHAVELA.

*Xystaema cinereum* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1373, part.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 114.—SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 382.

*Gerres simillimus* REGAN, Biologia Centrali-Americana, Pisces, 1906, p. 38, pl. 8, fig. 2; Rio Presidio, Mexico.

Four specimens, field No. 301, 10.8 to 12.7 cm. long, from Eten, taken in Rio de Eten, about 1 mile from the mouth.

Head 2.9 in length; depth 2.35; eye 3.2 in head; snout 3.2; maxillary 2.9; interorbital 3.2; D. IX, 10; A. III, 8; scales 6-40 (+3)-12; gillrakers short, 4+7.

Body compressed, angular; dorsal outline strongly arched, greatest depth under origin of dorsal; ventral outline in front of anal comparatively straight, base of anal oblique; caudal peduncle slender, its depth a little greater than diameter of eye; snout pointed; interorbital broad and flat, profile from tip of snout to origin of dorsal nearly straight; eye large; mouth moderate; maxillary nearly reaching the vertical from anterior margin of pupil; anterior ventral outline of head slightly concave; no serrations on preopercle and preorbital.

Third dorsal spine longest, 1.88 in head; soft dorsal low; caudal deeply forked, longer than head; second anal spine longer and stronger than the third, 2.13 in head; dorsals and anal inclosed in a scaly sheath; ventrals reaching to posterior border of vent, 1.45 in head; pectorals longer than head, tips reaching vertical from origin of anal, 0.94 in head. Scales large, regular; lateral line parallel with back.

Color in alcohol: Silvery, dusky on back, sides crossed by 7 or 8 broken, dusky, vertical bars; fins dusky; tips of spinous dorsal membranes black. Described from an individual 12.7 cm. in length from Eten.

Regan states that this species differs from the Atlantic representative (*X. cinerum*) in the fewer scales, larger head, longer maxillary, and longer second anal spine, whilst the bars on the sides are usually more numerous.

#### Genus GERRES Cuvier.

##### MOJARRAS.

##### KEY TO SPECIES.

- $\alpha^1$ . Preorbital entire; no distinct dark streaks along the rows of scales. *peruvianus*, p. 92.  
 $\alpha^2$ . Preorbital serrate; a distinct dark streak along rows of scales on back and sides.-----*periche*, p. 93.

#### 121. GERRES PERUVIANUS Cuvier and Valenciennes.

##### PERICHE.

*Gerres peruvianus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 6, 1830, p. 487; Paiti (Payta), northern Peru.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1376.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 115.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 792.

One specimen, field No. 1040, 10.5 cm. long from Capon.

Head 2.8 in head; depth 1.91; eye 3.33; snout 3.33; maxillary 2.75; interorbital 3.33; pectoral 1; ventral 1.33; D. IX, 10; A. III, 8; scales 6-36-9 or 10.

Body short, compressed, rhomboidal, depth about 2 in length; dorsal outline strongly arched; ventral outline straighter; caudal peduncle slender, its depth 2.5 in head; head short and pointed; interorbital broad, concave, equal in width to diameter of eye and length of snout; mouth moderate; maxillary extending to vertical from anterior border of pupil; preorbital very narrow, without serrations; margin of preopercle with fine, even serrations; pre-

maxillary groove broad, oval; dorsal spines high, slender, fin falcate; dorsal and anal fitting into a scaly sheath; second anal spine longest, 1.5 in head, considerably stronger than the third which is very slender, fin falcate; ventrals reaching midway between vent and origin of anal; pectorals as long as head, reaching vertical from origin of anal.

Color in alcohol: Silvery, fins dusky.

Description based on a small specimen 10.5 cm. in length from Capon.

121. *GERRES PERICHE*, new species.

*PERICHE*.

Plate 8, fig. 3.

Head 2.8 in length; depth 2.16; eye 3.97 in head; snout 2.97; maxillary 2.54; interorbital 3.5; pectoral 1.09; D. X, 9; A. III, 8; scales 6- (+3)-11.

Body short, deep, moderately compressed; snout blunt, considerably longer than horizontal diameter of eye; premaxillary groove very broad, without scales; mouth moderate; maxillary reaching vertical from anterior border of pupil; premaxillary groove reaching below middle of eye; teeth small; upper profile of head concave; interorbital broad; cheeks and opercles scaly, the scales on opercles large; several small scales on preopercle; preorbital and preopercle serrated, serrations on the preorbital weak.

Dorsal spines strong, the second longest and strongest, 1.67 in head; no notch between the dorsals, only 8 rays apparent above the broad scaly sheath of the dorsal, the third ray partially aborted; dorsal forked (lobes broken); second anal spine long and strong, 2.04 in head, the third longer but much slenderer, 1.98 in head; tips of ventrals reaching midway between vent and origin of anal; ventral spine stout, compressed, knife-like, 2.22 in head; pectorals long, falcate, their tips reaching vertical from origin of anal; scales large, heavy, regular in arrangement; lateral line curved, parallel with dorsal outline; 34 pores on fully developed scales of lateral line, 4 pores on smaller scales at base of caudal; a wide scaly sheath on base of dorsal and anal; the width 2.31 in eye.

Color in alcohol: Silvery, tinged with yellow, a black line along each row of scales above base of pectoral, about 9 of these black lines; no black area in axil of pectoral.

This species resembles *G. lineatus*. From specimens of *G. lineatus* from San Juan Lagoon in the United States National Museum it differs in having a longer head; snout longer than eye; pectoral not as long as head; smaller scales; and the black lines along the rows of scales more pronounced. The back is not quite as strongly arched

but does not present the marked difference stated to exist between *G. lineatus* and *G. brevimanus*.

One specimen, the type, No. 77743, U. S. Nat. Mus. (field No. 1013), 26.5 cm. long, from Tumbes.

## Family KYPHOSIDAE.

### THE RUDDERFISHES.

#### Genus DOYDIXODON Valenciennes.

#### 123. DOYDIXODON LAEVIFRONS (Tschudi).

#### BABUNCO; GALLINAZO.

*Pimblepterus laevifrons* TSCHUDI, Fauna Peruana, Fishes, 1845, p. 18; Huacho.

*Doydixodon fasciatum* KNER and STEINDACHNER, Neue Fisch. Mus. Godefroy, Sitz. Akad. Wiss. Wien, vol. 54, 1868, p. 358, pl. 1, fig. 2; Iquique.

*Doydixodon laevifrons* JORDAN and FESLER, Rev. Sparidae, Rep. U. S. Fish Comm., 1889-1891 (1893), p. 532.—STEINDACHNER, Fauna Chilensis, 1898, p. 289.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 351; Herpet.-Ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 29.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 792, pl. 68, fig. 2.

Two specimens, field Nos. 09718 and 09705, respectively 27 and 31.5 cm. in length, from Mollendo; and one specimen, field No. 09485, 36 cm. in length, from Lobos de Afuera.

Head 3.45 in length; depth 2.42; eye 5.8 in head; snout 2.5; interorbital 2.3; pectoral 1.2; D. XII, 15; A. III, 12; scales 15-55 (+3)-20.

Body deep, ovate, caudal peduncle deep, compressed, depth 2.81 in head; snout blunt, convex; interorbital broad, rounded; eye small, 2.33 in snout, 2.53 in interorbital; teeth small, compressed, those on mandible in five oblique rows, running downward and inward toward the symphysis; a broad band of smaller teeth behind the incisors; gape of mouth reaching nearly to vertical from anterior border of pupil; jaws subequal, the lower slightly included; scales regular in arrangement, those above lateral line anteriorly small, increasing in size posteriorly; a few scales on upper part of opercle; cheek scaled; preopercle, subopercle, and snout naked; soft dorsal falcate, longest ray 1.55 in head; caudal concave, upper lobe longer; distal portion of anal concave, anterior rays longest, 1.33 in head; ventrals not reaching vent, 1.47 in head; pectoral angulated.

Color in alcohol: Back dusky; belly reddish brown; fins dusky. Description of a specimen 36 cm. in length from Lobos de Afuera.

A specimen (field No. 09705) 31.5 cm. in length, from Mollendo, has head 3.14 in length; depth 2.31; eye 5.2 in head; snout 2.51; inter-orbital 2.43; pectoral 1.2; height of soft dorsal 1.73; height of anal 1.52; D. XII, 16; A. III, 13.

Field No. 09718 has D. XII, 16; A. II, 12.

These individuals present the same differences between this species and *D. freminvillei* from the Galapagos Islands as described and figured by Starks.<sup>1</sup>

## Family SCAENIDAE.

### THE CROAKERS.

#### KEY TO GENERA.

- a<sup>1</sup>. Vertebrae 14 or 15+10 or 11, the abdominal portion of the spinal column having always more vertebrae than the caudal portion.....*Cynoacion*, p. 96.
- a<sup>2</sup>. Vertebrae 9 to 12+13 to 20, typically 10+14, the number in the abdominal part of the body being always fewer than in the caudal part; dorsal fins contiguous, the soft dorsal being long, much longer than the anal.
- b<sup>1</sup>. Lower jaw without barbels.
  - c<sup>1</sup>. Mouth more or less oblique; preorbital usually narrow, flat; edge of snout above upper jaw with the pores and slits little conspicuous or obsolete.
  - d<sup>1</sup>. Head not very broad, the interorbital space not notably spongy nor deeply cavernous; preopercle with its membranaceous edge entire, crenulate or ciliate, with no bony teeth; teeth in lower jaw in few series.....*Larimus*, p. 98.
  - d<sup>2</sup>. Head very broad above, the interorbital space flattish, excessively cavernous, the septa reduced to thin partitions; soft dorsal and anal fins usually densely scaly.....*Stellifer*, p. 99.
  - c<sup>2</sup>. Mouth more or less inferior; snout above lower jaw with large pores and with two more or less distinct slits on its edge; preorbital more or less broad; preopercle without bony serrations, its membranaceous edge entire or crenate or fringed.....*Sciaena*, p. 101.
- b<sup>2</sup>. Lower jaw with one or more barbels, either at the symphysis or on the ramal; snout with slits and pores as in *Sciaena*; lower jaw included; pre-orbital broad; lower teeth in villiform bands.
- c<sup>3</sup>. Pseudobranchiae well developed; pectoral fin not elongate. Lower jaw with a single thickish barbel at its tip.
  - d<sup>1</sup>. Air bladder large; anal spines 2; back more or less elevated; preopercle with its bony margin crenate or serrate; pectorals short, shorter than ventrals.....*Umbrina*, p. 105.
  - d<sup>2</sup>. Air bladder none; anal spine single, weak; back not elevated; preopercle with its membranaceous edge crenulate; pectoral fins usually long, longer than ventrals.....*Menticirrhus*, p. 106.
  - c<sup>4</sup>. Pseudobranchiae weak or obsolete; if present, covered by membrane; pectoral fin elongate; mandible with a row of slender barbels along its inner edge, and tuft of barbels at chin.....*Polyclemus*, p. 108.

<sup>1</sup> Fishes from Ecuador and Peru, p. 792, pl. 66, figs. 1 and 2.

## Genus CYNOSCIION Gill.

## KEY TO SPECIES.

- $\alpha^1$ . Anal with more than 12 soft rays.....*analis*, p. 96.  
 $\alpha^2$ . Anal with fewer than 12 soft rays.  
 $b^1$ . Scales not very small, the number of transverse series ranging from 55 to 75, being not much in excess of the number of pores; pectoral fins short, reaching little past middle of ventrals, their length not more than one-half head; scales smaller (10-73-10), 60 pores in the lateral line.....*stolzmanni*, p. 97.  
 $b^2$ . Scales comparatively small, the number of transverse rows ranging from 85 to 90, usually about 80 pores in the lateral line....*phosocephalus*, p. 97.

## 124. CYNOSCIION ANALIS (Jenyns).

- Otolithus analis* JENYNS, Zool. Voy. *Beagle*, Fishes, 1842, p. 164; Callao.  
*Otolithus peruanus* TSCHUDI, Fauna Peruana, Ichthy., 1845, p. 10; Coast of Peru.  
*Ancylodon altipinnis* STEINDACHNER, Ichth. Notizen, vol. 3, 1866, p. 2, pl. 1, fig. 3; west coast of South America.  
*Archoscion analis* JORDAN and EIGENMANN, Rep. U. S. Fish Comm., 1886 (1889), p. 353; Callao.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 352.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 793.  
*Archoscion altipinnis* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 353.  
*Archoscion peruanus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 353.  
*Isopisthus analis* STEINDACHNER, Herpet-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 31; Païta.

The validity of *Cynoscion altipinnis* (Steindachner), and *Cynoscion peruanus* (Tschudi), seems very questionable and we follow Jordan and Eigenmann in placing them in the synonymy of this species. Steindachner's original description of *C. altipinnis* is based on a specimen 17.8 cm. (7") long, considerably smaller than those described by Abbott, and as he himself states "the most important difference (between the two) seems to lie in the lack of developed opercular spines in *analís*, while the other species (*altipinnis*) has two quite strong spines." Steindachner<sup>1</sup> calls attention to the fact that in a specimen of *analís* 21 cm. long the eye is 5 in head and in individuals 32 cm. long it is contained 6 times. He also includes *Archoscion analis* of Jordan and Eigenmann in his synonymy, which by Abbott has been included in the synonymy of *altipinnis*, originally described by Steindachner and later placed by him in synonymy of *analís*. Tschudi's description of *peruanus* is based on a large individual (1' 3") and agrees closely with the descriptions of *analís*.

<sup>1</sup> Herpet.-ichthyol. Südamerika.

125. *CYNOSCIION STOLZMANNI* (Steindachner).

*Otolithus stolzmanni* STEINDACHNER, Neue und Seltene Fische Arten k.k. Zool. Mus., Denkschr. Akad. Wiss. Wien, vol. 41, 1879, p. 35, pl. 2, fig. 1; Tumbes, Peru.

*Cynoscion stolzmanni* JORDAN and GILBERT, Bull. U. S. Fish Comm., 1881, p. 820.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1412.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 354.

126. *CYNOSCIION PHOXOCEPHALUS* Jordan and Gilbert.

*Cynoscion phoxocephalum* JORDAN and GILBERT, Bull. U. S. Fish Comm., 1881, p. 318; Panama.

*Cynoscion phoxocephalus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1413.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 120.

One example, field No. 1036, 29.5 cm. long, from Capon, near Tumbes.

Head 3 in length; depth 4.46; eye 6.46 in head; snout 4; maxillary 2.4; interorbital 4.93; pectoral 2; D. IX-I, 21; A. III, 10; scales 18-90-15, pores about 60. Body moderately elongate fusiform; head conical, little compressed, profile from tip of lower jaw to origin of dorsal nearly straight; mouth large, oblique, maxillary reaching to below posterior border of orbit; teeth differing in no essential characters from those of other species of *Cynoscion*; as stated by Gilbert and Starks, "the premaxillary teeth are in a band throughout, which contain everywhere more than two series. Along the sides of the jaw the outer series consists of stronger conical teeth which are scarcely larger than those behind them. Anteriorly the band widens and bears along its posterior edge a converging pair of small canines. The mandibular band is widest near the symphysis, where it consists of three series, those of the outer series somewhat stronger than the others. Laterally the band rapidly narrows, at first to two series, the inner of strong conical teeth, the outer very small; then the outer series disappears, those of the remaining series increasing in size toward the angle of the mouth."

Dorsal fins separate, the spines of the first dorsal slender, the third and fourth longest, reaching nearly to tip of last spine; second dorsal rather low, scaleless; anal moderate, the spines small; ventrals short, 2 in head; pectorals rather narrow, equal to ventrals. Scales small, regular in arrangement, transverse rows above lateral line very oblique; scales on cheek large, imbedded, covered with a transparent skinlike covering, those on top of head small, crowded; lateral line with a very slight arch anteriorly, becoming straight above vent, scales enlarged but covered with smaller scales.

Color in alcohol: Silvery brown; fins brownish; inside of opercle black; a blackish humeral area concealed by gillcover.

Jordan and Evermann give the following colors in life: Dark above with strong bright reflections of purplish-brown; silvery below, the lower part of the caudal peduncle golden yellow; middle of sides noticeably punctulate with brown dots; inside of mouth deep orange-yellow; lining of opercle black; dorsal and caudal fins dusky whitish, with more or less dark edging; lower rays of caudal yellowish; fins otherwise translucent, unmarked; axil of pectoral light yellowish above; the silvery color of the sides of the head and the bright reflections on its upper surface very conspicuous, more so than in any other species of the genus.

Length 2 feet; a neat and well-marked species. Pacific coast from Panama to Peru; previously recorded only from Bay of Panama where it is abundant.

Genus **LARIMUS** Cuvier and Valenciennes.

127. **LARIMUS PACIFICUS** Jordan and Bollman.

**BRECHER.**

Plate 9, fig. 1.

*Larimus pacificus* JORDAN and BOLLMAN, Proc. U. S. Nat Mus., vol. 12, 1899, p. 161; Pacific Ocean, off coast of Colombia, at Albatross Station 2802. 8° 28' N.; 79° 31' 30" W., between Galapagos Islands and Panama.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1424.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 124.

One specimen, field No. 09525, 25 cm. long, from Lobos de Tierra; and one, field No. 09127, 17.3 cm. long, from Callao.

Head 2.98 in length; depth 3.15; horizontal diameter of eye 4.75 in head; snout 4.15; maxillary 2.12; interorbital 3.88; pectoral 1.14; D. X-I, 27 ( $\frac{1}{2}$ ); A. II, 6 ( $\frac{1}{2}$ ); scales 7-44 (+5)-10; gillrakers 10+20, long, slender, equal to diameter of eye.

Body compressed, slender, not so heavy forward as in related species; back regularly rounded from snout to last dorsal rays; belly evenly arched anteriorly, base of anal very oblique, caudal peduncle slender; snout short, mouth rather large, oblique, the maxillary reaching to below posterior border of pupil; lower jaw projecting; eye moderate; scales large, regular, those on body including breast, ctenoid; those on head, cycloid; base of soft dorsal and anal with a scaly sheath; membranes scaly; dorsal high, first spine very small, almost concealed by skin, the fourth largest, 2.1 in head; second dorsal moderate; caudal with middle rays longest, lanceolate in shape; anal small, first spine very small, the second shorter than soft rays, 3.8 in head; ventrals short, 1.65 in head, not reaching to tip of pectoral.

Coloration in alcohol: Back dusky; sides yellowish; centers of scales dusky, forming dusky stripes along rows of scales, those above lateral line parallel with it to below origin of soft dorsal where they turn obliquely upward, those nearest back being the first to turn upward and those on caudal peduncle again following rows of scales parallel with lateral line, those below lateral line slightly wavy, horizontal, these becoming silvery on belly; fins dusky yellow; axil of pectoral black; skin lining region around pseudobranchiae black, this showing through opercle as a dark area.

This species has the general color pattern of *L. acclivis*, differing in having the dark streaks above lateral line anteriorly parallel with it instead of oblique. This description is based on a specimen 25 cm. long from Lobos de Tierra.

The individual from Callao has head 2.98 in length; depth 3.1; eye 4.15 in head; snout 4.18; maxillary 2.18; interorbital 3.55 pectoral 1.2; D. X-I, 27; A. II, 6 ( $\frac{1}{2}$ ).

Genus STELLIFER (Cuvier) Oken.

128. STELLIFER MINOR (Tschudi).

MOJARILLA.

Plate 9, fig. 2.

*Corvina minor* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 9; Coast of Peru, Lima market.

*Solaena minor* GÜNTHER, Cat. Fish. Brit. Mus., vol. 2, 1860, p. 295.

*Corvina (Homoprion) agassizii* STEINDACHNER, Ichthy. Beitr., vol. 2, p. 26, Sitz. Akad. Wiss. Wien, vol. 71, 1875; Callao.

*Corvina agassizii* COPE, Proc. Amer. Philos. Soc., May, 1877, p. 42; Pacasmayo and Chimbote bays.

*Stellifer minor* JORDAN and EIGENMANN, Rev. Sciaenidae, Rep. U. S. Fish Comm., 1886 (1899), p. 393.

*Stellifer minor* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 354.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 793.

*Stellifer agassizii* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci., Phila., 1899, p. 355.

One specimen, field No. 09427, 15.9 cm. long, from Pacasmayo, taken with hook and line from the pier, and one, field No. 09170, 15 cm. long, from Chimbote.

Head 3.16 in length; depth 2.8; eye 5.1 in head; snout 4; interorbital 2.8; maxillary 2.5; pectoral 1.05; D. XIV, 20; A. II, 11; scales 8-53-14.

Body compressed, dorsal outline more strongly curved than ventral; head broad, cavernous, region over eye somewhat depressed; snout bluntly rounded, scarcely overlapping the premaxillaries; mouth moderate, oblique; maxillary reaching to below middle of

pupil; teeth in lower jaw in a villiform band, those on premaxillaries similar, but with an outer row of enlarged, curved caninelike teeth, these decreasing in size toward angles of mouth; vertical limb of preopercle with 5 moderate spines, the lowermost strong, directed downward; several spines on the horizontal limb of the preopercle, these projecting but little below the integument; nostrils rather small, the posterior close to orbit; gillrakers very long and slender, 6+24, the longest at angle of arch, 1.23 in eye.

First dorsal spine very small, the fourth longest, 2.1 in head; fourth to tenth growing shorter, eleventh to fourteenth again increasing in length; all the spines rather weak; caudal subtruncate; second anal spine considerably longer than first but shorter than soft rays, 3 in head; ventrals not reaching vent, 1.4; pectoral long, reaching to below origin of soft dorsal. Scales on body ctenoid, those on head weakly ctenoid; soft parts of vertical fins scaled to their tips. In life, this specimen was much darker and the stripes more distinct than in individuals from Chimbote. Ground color light, with dark stripes along rows of scales; 11 stripes distinguishable below the lateral line, seven above the pectoral; white of belly extending up on lower part of sides for only one-fourth inch; all fins rather dusky with only faint traces of yellowish orange; faint reddish orange on ventrals.

Color in spirits: Back very dark, sides lighter, becoming white on ventral surface; centers of scales dark, these forming lines along rows of scales; center of opercle with a dusky black area; vertical fins dusky; paired fins lighter; base of pectoral dusky. Description based on a specimen 15.9 cm. long from Pacasmayo.

An individual from Chimbote has head 3.02 in length; depth 2.75; eye 5 in head; snout 3.8; maxillary 2.47; interorbital 3; pectoral 1.35; D. XIII, 20; A. II, 11. Color in life: There is some variation in the coloration of this species, but a fish of ordinary markings has the following coloration: Ground color light, especially below; belly and lower part of sides for three-fourths of an inch or more, white; inconspicuous stripes (6+) below the lateral line, five of these being above the pectoral; other stripes above the lateral line, but they are seen very indistinctly in the darker coloring of the upper part of body. Fins (anal, pectoral, and caudal) yellowish orange, somewhat dusky, pectoral with some reddish orange; ventrals reddish orange with hardly any duskiness.

We are unable to find sufficient differences between *Corvina agassizii* of Steindachner and *Corvina minor* of Tschudi to separate the two and believe that they are one.

This species is found along the coast of Peru, and is most nearly related to *Stellifer illecebrosus* Gilbert, from Panama Bay.

## Genus SCIAENA (Artedi) Linnaeus.

## THE BLACK DRUMS.

## KEY TO SPECIES.

- a<sup>1</sup>. Transverse rows of scales above lateral line 50 to 55; head 2.75 to 3 in length.
- b<sup>1</sup>. D. IX or X, I, 25; scales 13-53-20; opercle ending in broad, truncate, centrarchid-like flaps; eye 4.5 to 5.25 in head-----*fasciata*, p. 101.
- b<sup>2</sup>. D. IX or X, I, 22 or 23; scales 7-53-12; eye 5.5 to 6 in head.*delictosa*, p. 102.
- a<sup>2</sup>. Transverse rows of scales above lateral line 60 to 85; head 3.2 to 3.4 in length.
- c<sup>1</sup>. Eye moderate, 5.5 to 6.25 in head; scales 11-60-15-----*gilberti*, p. 103.
- c<sup>2</sup>. Eye small, 7.5 to 11 in head; transverse rows of scales above lateral line more than 65.
- d<sup>1</sup>. Eye very small, 9.5 to 11 in head, 3 in snout; depth less than length of head; transverse rows of scales above lateral line 68-*starksi*, p. 104.
- d<sup>2</sup>. Eye larger, 7.5 in head, 2 in snout; depth equal to length of head; rows of scales in lateral line (reported) 85-----*weineri*, p. 105.

## 129. SCIAENA FASCIATA (Tschudi).

## GALLINAZO.

*Chelotrema fasciatum* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 13, pl. 1; Caleta of Chancay, between Callao and Huacho.

*Corvina fasciata* GÜNTHER, Cat. Fish. Brit. Mus., vol. 2, 1860, p. 305.—STEINDACHNER, Ichth. Notizen, vol. 7, 1868, p. 21.

*Sciaena fasciata* JORDAN and EIGENMANN, Review of Sciaenidae, Rep. U. S. Fish Comm., 1886 (1889), pp. 403, 407.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 356.—DELFIN, Cat. Peces de Chile, 1901, p. 69.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 793.

One example, field No. 09164, 27.5 cm. long, from Chimbote.

Head, including flap, 3 in length; depth 2.6; eye 5.2 in head; snout 3.7; maxillary 3.12; interorbital 3.2; width of broad centrarchid-like opercular flap above opercular base 3; pectoral 1.56; ventrals 1.47; D. IX, I, 25; A. II, 9; P. 18; scales 13-53-20, those above lateral line in very oblique rows.

Body short, deep, the back elevated, anterior profile very steep and rounded; head high, ending in a broad, truncate opercular flap; snout short, blunt, very high, projecting slightly beyond tip of mandible; eye small, less than interorbital width, 1.4 in snout; mouth small, inferior, slightly oblique; maxillary reaching to below middle of pupil; lips papillose; teeth in broad bands in each jaw, the outer row on the premaxillaries somewhat enlarged; vertical border of preopercle nearly smooth, a few small fleshy serrations present; gill-rakers very short and stout, armed with small spine-like prickles, 4+8, the last rudimentary.

Scales on head and body strongly ctenoid, the transverse rows on body very oblique; membranes of soft-rayed fins densely scaly to

their tips; tip of snout and area around mouth naked; fourth dorsal spine longest, 2.6 in head; soft dorsal evenly rounded; posterior border of caudal truncate; first anal spine very short, second anal spine stout, shorter than soft rays, 3.25 in head; ventrals longer than pectorals, reaching about two-thirds the distance from their base to vent; pectoral short.

Color in alcohol: Dusky gray, lower parts silvery; a conspicuous light band equal in width to orbit, extending downward and backward from below last dorsal spine to in front of the vent; another irregular light area under middle of soft dorsal; fins dusky gray, tips of anal and ventrals darker; base of pectoral black, opercle ending in a broad truncate, jet black opercular flap.

In the figure of this species as given by Tschudi, the opercular flap is not distinctive, although he mentions the characters of this flap in his description.

This remarkable species is found on the coasts of Peru and Chile; not common.

130. *SCIAENA DELICIOSA* (Tschudi).

LORENA: CHOLO.

Plate 9, fig. 3.

*Corvina deliciosa* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 8; Peru.

*Sciaena deliciosa* JORDAN and EIGENMANN, Rev. Sciaenidae, Rept. U. S. Fish Comm., 1886 (1889), pp. 401, 406.—JORDAN and EVERMANN, Fishes of North and Mid. Amer., vol. 2, 1898, p. 1455.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 356.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 132.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 794.

Two examples, field Nos. 09135 and 09138, respectively 21 and 22.5 cm. long., from Callao (Lima Market), and one, field No. 517, 22 cm. long, from Mollendo.

Head 2.9 in length; depth 3.4; eye 6 in head; snout 4; interorbital 3.8; maxillary 2.93; pectoral 1.34; D. X, I, 20; A. II, 9; scale 7-51-12, 50 pores in lateral line to base of caudal.

Body compressed, dorsal outline forming a regular curve from tip of snout to base of caudal; ventral outline straighter; head compressed; interorbital rounded; snout rather blunt, slightly projecting beyond tip of mandible; slits and pores on tip of snout well developed; anterior nostril round, midway between tip of snout and anterior border of orbit; posterior nostril an elongate slit; eye rather small, considerably less than interorbital space, the latter equaling snout; maxillary reaching to below middle of pupil (in some specimens to below its posterior border); mouth rather large, oblique, the lower jaw slightly included; preopercle finely and

evenly serrate on its vertical border, the serrations at angle on horizontal border somewhat enlarged; teeth in villiform bands, unequal, an outer row on the premaxillary somewhat enlarged; gillrakers small, slender, 6+14, the longest at angle equal to diameter of pupil.

Scales regular, slightly deciduous; soft dorsal and anal scaled at base only, the scales extending but a short distance on the membranes.

Dorsal spines moderate, the 4th longest, 2.74 in head; soft dorsal low, rays graduated; caudal lunate, upper lobe longer; first anal spine very small, second slender, 3.5, much shorter than soft rays; ventrals short, reaching one-half distance from their base to posterior border of vent; pectoral reaching to below origin of soft dorsal.

Color in alcohol, dusky on back and sides, becoming silvery on belly; faint dark lines following rows of scales; a dark area on opercle; fins dusky; axil of pectoral blackish. Description based on a specimen 22.5 cm. long from Callao.

An example from Mollendo has 23 dorsal rays and the belly and sides strongly silvery.

This species does not attain as large a size as some of the other important food fishes of the genus, but it is one of the most abundant and highly prized food fishes on the coast of Peru. It is abundant at Callao and has been recorded as far north as Panama.

#### 121. *SCIAENA GILBERTI* Abbott.

#### COBBINA: COBBINITA.

Plate 10, fig. 1.

*Sciaena gilberti* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 355; Callao.—STEINDACHNER, Herpet.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 32; Callao.

Three specimens, field Nos. 09727 (=09102), 09104 and 09111, respectively 33, 28.5, and 38 cm. long, from Callao, taken with gillnet, fishing in the surf at La Ventanilla, between Ancon and Callao.

Head 3.3 in length; depth 3.52; eye 6 in head; snout 3.16; maxillary 2.54; interorbital 4; D. IX-I, 23; A. II, 9; scales 11-60 (+5)-14, 60 pores.

Body elongate, fusiform, back little elevated; curvature of dorsal and ventral outlines similar; head not elevated; snout rather long and sharply pointed, not projecting beyond mandible; mouth large, oblique; maxillary extending to below middle of pupil; posterior nasal slit shorter and larger than usual in related species; free margin of preopercle armed with small, equal serrae, these weak and rather flexible; teeth in jaws in two or three rows, the outer row slightly enlarged; third dorsal spine longest, 2.18 in head, outline of fin triangular; soft dorsal highest anteriorly; caudal lunate; first anal spine very small, the second slender, about 1.75 in longest anal ray,

3.61 in head; ventrals placed well forward, their tips reaching halfway from base of ventrals to posterior end of vent; pectoral longer than ventrals, 1.5 in head; scales ctenoid, those on head and body anteriorly small, crowded, those under base of last dorsal rays much larger; transverse rows anteriorly very oblique; a small area on tip of snout and mandible, anteriorly without scales; lateral line curved anteriorly, following outline of back, becoming straight above middle of anal; gillrakers long, 9+15.

Color in alcohol: Olivaceous; a narrow central streak on each scale of lighter olive, these forming rows following the rows of scales; fins somewhat dusky; a dark area on opercle. Description based on a specimen 33 cm. long from Callao.

In other specimens the head is 3.2 to 3.31 in length; depth 3.28 to 3.62; eye 5.5 to 6.12 in head; snout 3.8; maxillary 2.56 to 2.6; interorbital 3.82 to 4.1; preorbital 8.8 to 9; pectoral 1.5; ventral 1.9 to 1.97; third dorsal spine longest, 2.2 to 2.5; second anal spine 3.15 to 3.6; gillrakers 9+15, the longest 1.92 in eye; D. IX-I, 23; A. II, 9 or 10. In these specimens the general color is rufous brown, dusky on back.

Dr. Robert E. Coker writes that this fish grows to a large size, 30 to 40 pounds, and is one of the most highly prized food fishes of Peru. It is present all the year in the region about Callao, but more abundant in the summer.

### 132. *SCIAENA STARKSI*, new name.

#### ROBALO; ROBALITO.

*Sciaena gilberti* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 794, pl. 66, fig. 3; Callao; name preoccupied.

Two specimens, field Nos. 09732 (=09100) and 09731 (=09101), each 47 cm. long, from Callao.

Starks, in his Fishes from Ecuador and Peru,<sup>1</sup> describes and figures this species and gives it the name *S. gilberti*. Abbott, in his Marine Fishes of Peru,<sup>2</sup> also described a new species from Callao to which he gave the name *S. gilberti*. As Abbott's use of the name has priority over its use by Starks, we propose the name *S. starksi* for the species described by the latter.

Head 3.36 in length; depth 4; eye 10.6 in head; snout 3.6; maxillary 2.42; interorbital 3.3; preorbital 14.8; pectoral equal to ventrals, 1.98; D. X, I, 22 ( $\frac{1}{2}$ ) to 23 ( $\frac{1}{2}$ ); A. II, 10; scales 10-68-16.

Body compressed, long, slender, spindle-shaped; head slender, depressed, the interorbital space very broad, 3.2 times horizontal diameter of eye, which is very small, 9.5 to 11 in head, 3 in snout; mouth large, oblique, the lower jaw slightly included; maxillary

<sup>1</sup> Proc. U. S. Nat. Mus., vol. 30, 1906, p. 794.

<sup>2</sup> Proc. Acad. Nat. Sci. Phila. 1899, p. 355.

reaching a little past posterior border of eye (the statement by Starks that it reaches a little past anterior border of eye, is undoubtedly a misprint, as in his figure and our specimens it reaches slightly past the vertical from posterior border of eye); teeth in upper jaw in two or three irregular rows, the outer of these much enlarged, those on lower jaw in two rows, the inner being the larger; gillrakers 4+10, covered with spinules, the longest nearly equal to horizontal diameter of eye; entire margin of preopercle with small, rather widely separated, denticulations; third and fourth dorsal spines about equal, longer than the others, 2.7 in head; soft dorsal rather low, highest anteriorly; caudal lunate; anal spines small, the second 4 in longest ray; pectorals and ventrals short. Scales ctenoid; dorsal and anal with scaly sheath; caudal scaled two-thirds way to its tip; a small area at base of pectoral scaled; head scaly except tip of snout, maxillary and mandibles.

Ground color in spirits: Olivaceous, dusky on back; scales crossed by a dark line, these forming lines following the rows of scales; dorsals, caudal, and pectorals dusky; anal and ventrals lighter; axil of pectoral dusky; a dusky area showing through opercle.

Starks states that this species differs from *S. wieneri* Sauvage "in having the length of the head greater than the depth and longer as compared with the entire length; the snout shorter as compared with the interorbital space; the eye smaller; the caudal lunate; and the scales larger."

Dr. R. E. Coker states that of the three species "lorna" (*S. deliciosa*), "corbina" (*S. gilberti*), and "robalo" (*S. starksi*), the "corbina" is much the best food fish. The "robalo" reaches a larger size, 30 to 40 pounds or larger. It is more abundant in summer and is usually fished near the bottom, sometimes at a depth of 15 to 20 fathoms, although it is occasionally taken at the surface.

### 133. *SCIAENA WIENERI* Sauvage.

*Sciaena wieneri* SAUVAGE, Bull. Soc. Philom., July 7, 1883, p. 156; Peru.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 356.

This species is known only from the original description and appears to be most closely related to *S. starksi*.

### Genus UMBRINA Cuvier.

#### 134. *UMBRINA XANTI* GIL

#### POLLA.

*Umbрина xanti* GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 256; Cape San Lucas.—JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 4, 1881, p. 278.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1468.

*Umbrina analis* GÜNTHER, Fishes Central America, 1860, pp. 387, 426; Panama.

One specimen, field No. 1010, 28 cm. long, from Tumbes.

Head 3.65 in length; depth 3.45; eye 5.15 in head; snout 3; maxillary 3; interorbital 3.82; D. X-I, 30; A. II, 7; scales 8-54-13.

Body elongate, compressed, dorsal outline strongly and evenly arched; head conical; snout pointed; mouth horizontal, small, maxillary reaching to below center of eye; border of preopercle sharply and evenly serrate; third dorsal spine longest, 1.71 in head; second anal spine long and well developed, 2.6; pectoral rather small, equal in length to ventrals, the tips of the latter reaching halfway from their base to second anal spine; scales ctenoid, in very oblique rows; membranes of soft dorsal and caudal scaled two-thirds distance to tips; anal with a scaly sheath at base; a considerable area at base of pectoral scaled. "Vocal powers well developed." (Coker.)

Color in life, with many oblique and somewhat irregular stripes of dark brown.

Color in spirits, silvery; olive black stripes extending from head and pectoral region upward and backward along the rows of scales to the base of the dorsal, these somewhat wavy, becoming horizontal on caudal peduncle; fins yellowish.

### Genus MENTICIRRHUS Gill.

#### KEY TO SPECIES.

$\alpha^1$ . Eye 7 in head; scales 9-50 to 52-17 or 18; D. X, I, 20 or 21.

*panamensis*, p. 106.

$\alpha^2$ . Eye 6 in head; scales 12-70-20; D. XI, I, 23 or 24-----*cokeri*, p. 107.

#### 135. MENTICIRRHUS PANAMENSIS (Steindachner).

#### MUCHACHITA.

*Umbrina panamensis* STEINDACHNER, Ichth. Beil., vol. 4, 1875, p. 9; Panama.

*Menticirrhus panamensis* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1473.—GILBERT and STARKS, Fishes of Panama Bay, Mem. Cal. Acad. Sci., vol. 4, 1904, p. 134.

One example, field No. 1038, 26.4 cm. long, from Capon.

Head 2.82 in length; depth 4.07; eye 7.09 in head; snout 3.71; maxillary 3; interorbital 4.33; pectoral 1.3; ventral 2.22; D. X, I, 21; A. I, 9; scales 9-52 (+2)-17.

Body elongate, rounded, back strongly arched, its greatest depth at origin of dorsal; ventral outline nearly straight; head long, depressed, the interorbital broad and flat; snout blunt, strongly projecting beyond premaxillaries, maxillary extending to below posterior border of pupil; nostrils close together, the anterior provided with a small dermal flap; preorbital broad, equal to horizontal

diameter of orbit; teeth of lower jaw subequal, those of upper jaw similar but with an outer row of a few greatly enlarged canine-like teeth; border of preopercle with a few weak spinules; dorsal high, second dorsal spine longest, 2.1 in head; when depressed the tip of third spine reaching to origin of second dorsal; caudal S-shaped; ventrals small, reaching somewhat more than one-half the distance from their base to origin of anal; pectorals long and well developed, having their origin under middle of opercle and reaching to vent.

Color: Brownish, lighter on belly; fins dark, almost black.

This species is the most abundant representative of the genus at Panama; apparently rare outside of Panama Bay.

134. *MENTICIERHUS COKERI*, new species.

Plate 10, fig. 2.

*Type*.—Cat. No. 77533 U.S.N.M., 16.5 cm. long, and a paratype 16.7 cm. long, from Ancon, taken with seine on beach.

Head 3.45 in length; depth 4.18; eye 6.15 in head; snout 3.63; maxillary 3.63; preorbital 5.8; interorbital 3; D. XI, I, 23; A. I, 9; scales 12–70–20, 65 pores in lateral line to base of caudal.

In form this species closely resembles *M. panamensis*, but is at once recognized by the smaller scales; body elongate, little compressed; dorsal outline to base of soft dorsal evenly rounded, ventral profile straighter; head short, subconical, rather depressed, interorbital evenly rounded; snout blunt, projecting one-half diameter of eye beyond maxillaries; mouth small, inferior; maxillary reaching to below middle of eye; barbel short, stout; nostrils large, anterior edge of first midway between tip of snout and anterior margin of eye, close to second, and provided with a well-developed dermal flap which reaches to the second; teeth in lower jaw in a well-developed band, subequal; outer row of premaxillaries anteriorly, large, canine-like, becoming smaller posteriorly; margin of preopercle armed with small weak, fleshy serrae, projecting but little beyond the integument.

First dorsal spine very small, fourth longest, 1.9 in head, when depressed the fourth reaching to base of last dorsal spine, caudal somewhat broken, probably S-shaped; ventrals small, their base under origin of dorsal, their tips reaching halfway from their base to third anal ray; pectorals short, broad, not reaching to tip of ventrals, their base under posterior border of opercle, 1.33 in head; scales small, regular, ctenoid; soft dorsal with a low scaly sheath at base; scaly area on base of ventrals.

Color in alcohol: Dusky brown on back and sides, belly washed with brownish white; dorsals and caudal dusky; anal blackish distally, margined with lighter; distal half of ventrals black, margined with lighter; distal half of pectoral black.

The paratype has the head 3.4 in length; depth 4.25; eye 6 in head; snout 3.5; maxillary 3.5; interorbital 3; pectoral 1.4; ventrals 1.82; D. XII, 23; A. I, 9; scales 12-70-20.

This species has been named in honor of Dr. Robert E. Coker, who made important studies of the fishery resources of Peru, in connection with which he made the collections of fishes which form the basis of the present paper.

### Genus **POLYCLEMUS** Berg.

#### 187. **POLYCLEMUS PERUANUS** (Steindachner).

0000.

*Genyanemus peruanus* STEINDACHNER, Ichth. Beitr., vol. 2, p. 29, Sitz. Akad. Wiss. Wien, 1875; Paíta; Callao.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 357.

*Polycirrhus peruanus* JORDAN and EIGENMANN, Rev. Sclænidæ, Rep. U. S. Fish Comm., 1886 (1889), p. 415.

*Polyclemus peruanus* STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 796.

One example, field No. 09734 (=09112), 39.5 cm. long from Callao, taken with gill net, fishing in the surf at La Ventanilla, between Ancon and Callao.

Head 3.35 in length; depth 3.35; eye 6.4 in head; snout 3.42; maxillary 3; interorbital 2.75; pectoral 1.23; D. XI, I, 26 (25½); A. II, 8; scales 7-60-16.

Body elongate, back strongly arched; ventral profile nearly straight; head short, stout, depressed on snout and over eye, becoming strongly compressed on nape to origin of dorsal; interorbital space very broad; upper profile of head slightly concave, region over nape, convex; snout very blunt, projecting little beyond the maxillaries; mouth moderate, horizontal; maxillary reaching to below posterior border of pupil; border of preopercle with small, well-developed serræ; a tuft of slender barbels as long as diameter of pupil, at chin, those along inner edge of dentary bones separated by short interspaces; fourth dorsal spine longest, 2.76 in head; soft dorsal long and low, reaching to within a distance equal to length of snout from origin of caudal; caudal S-shaped; anal high, the longest ray 2.13 in head; ventrals long, their tips reaching halfway from base to third anal ray; pectoral broad, longer than ventrals, 1.25 in head; gillrakers short, less than diameter of pupil in length, covered with spinules, 6+10; scales strongly ctenoid; spinous dorsal fitting into a groove between scales; soft dorsal and anal with a scaly sheath at base; membranes of caudal scaled; a small patch of scales at base of pectoral. Color in alcohol, olivaceous, with traces of several dusky crossbands, most distinct under arched portion of lateral line.

This species has been recorded only from the coasts of Peru.

## Family OPLEGNATHIDAE.

## Genus OPLEGNATHUS Richards.

## 133. OPLEGNATHUS INSIGNIS (Kner).

## LORO; LORITO; PERICO.

*Scarostoma insigne* KNER, Neue Fische Mus. Godfroy, Sitz. Akad. Wiss. Wien, vol. 56, 1867, p. 7, pl. 2; West Coast of South America.

*Oplegnathus insignis* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1890, p. 359.

*Oplegnathus insigne* SNODGRASS and HELLER, Shore Fishes of the Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 397.

One specimen, field No. 09570, 16.5 cm. long, from Paita, and two specimens, field Nos. 09475 and 09501, respectively 21 and 4 cm. long, from Lobos de Afuera.

Head 3.03 in length; depth 2; eye 5.04 in head; snout 2.25; pectoral 1.31; D. XI, 17; A. III, 13.

Body strongly compressed, deep, greatest depth 2 in length; depth of caudal peduncle 2.2 in head; head short; snout pointed; eyes small; mouth small; maxillary reaching vertical from anterior border of eye; teeth soldered together, resembling the teeth of some of the scaroids; border of preopercle armed with fine serrations; opercle ending in a spine; dorsal spines stout, membranes deeply incised; soft dorsal and anal high, truncate; caudal lunate; anal spines short, stout, of about equal length; tips of ventrals reaching vent; pectoral short, not falcate; scales very small, strongly ctenoid; soft parts of vertical fins scaled; lateral line strongly arched, parallel with contour of back. Description of No. 09475 from Lobos de Afuera.

No. 09501, 4 cm. in length, from Lobos de Afuera, has head 2.66 in length; depth 2.13; eye 4 in head; snout 3.43; maxillary 3.43; pectoral 1.41; D. XI, 17; A. III, 13.

The marked changes in coloration at the different stages of growth noted by Snodgrass and Heller in Galapagos specimens are apparent in these. In the individual 4 cm. long the ground color is yellowish white crossed by black vertical bars, the first an ocular band meeting its fellow on nape and breast, slightly narrower than eye; the second from origin of dorsal downward and forward across opercle, bending backward across base of pectoral and meeting its fellow in front of base of ventrals; the third crossing posterior half of spinous dorsal and body, meeting its fellow on middle of area between ventral and anal base; the fourth extending across middle of soft dorsal, body, and anterior half of anal; fifth crossing posterior fourth of soft dorsal, caudal peduncle and tips of anal rays; the sixth narrower than the others and crossing base of caudal.

In the specimen 16.5 cm. long, black areas are beginning to appear in the white ground-color dorsally and on distal two-thirds of caudal. The largest specimen agrees well with Kner's illustration of this species.

Color in life of largest specimen: Gaudy with yellow and black; ground color black or nearly so with five (or six) bright yellow bands, completely encircling body at regular intervals, the first crossing head over posterior edge of preopercle, the second from anterior spines of dorsal, passing just behind ventrals, the third from beneath posterior spines of dorsal to anus and spines of anal, fourth halfway between third and fifth, the fifth crossing posterior part of caudal peduncle; these bands wider than eye, but are not solid, including many irregular-shaped black spots; dorsal and anal black with yellow marks—particularly in continuation of the bars on body; caudal mottled with black and yellow; pectoral yellow, with spots and marks of black; ventrals dorsally black, ventrally yellow in proximal part and black in distal region.

Specimens of *O. fasciatus* from Japan show no traces of black supplanting the white bands and have 12 instead of 11 dorsal spines, agreeing in other respects with this species.

### Family LATILIDAE.

#### Genus CAULOLATILUS Gill.

##### KEY TO SPECIES.

- $\alpha^1$ . Head 3.5 to 3.8 in length; depth 4; D. VIII, 26; A. II, 24 or 25; scales 18-118-40-----*princeps*, p. 110.  
 $\alpha^2$ . Head 2.8 to 3.1 in length; depth 3.1 to 3.3; D. VIII, 23 or 24; A. I, 22 or 23; scales 14-101-35-----*cabezon*, p. 111.

#### 139. CAULOLATILUS PRINCEPS (Jenyns).

##### PEJE-BLANCO; PEJE-FINO.

*Latilus princeps* JENYNS, Zool. Voy. *Beagle*, Fishes, p. 52, pl. 11; Chatham Island.

*Caulolatilus princeps* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 3, 1898, p. 2276.—STEINDACHNER, Herpet.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 35.—SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 417.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 799.

One specimen, field No. 09685, 29 cm. long, from Lobos de Afuera; one, field No. 09122, 26.8 cm. long, from Callao, Lima Market; and one, field No. 09701, 33 cm. long, from Pisco.

Head 3.55 to 3.75 in length; depth 3.9 to 4.1; eye 4.4 to 4.8 in head; snout 2.9 to 3.15; maxillary 2.8 to 3.1; interorbital 3 to 3.35; pectoral

1.1 to 1.2; ventrals 1.5 to 1.75; D. VIII, 26; A. II, 24 or 25; scales 16-118(+3)-40.

Body elongate, fusiform; head short, dorsal profile strongly convex; eye moderate, 1.5 in snout; interorbital broad, rounded; nostrils small, the anterior with a flap; mouth small, oblique; maxillary scarcely reaching vertical from front of eye; teeth small, fine, villiform; vertical border of preopercle evenly and finely serrate.

Scales small, strongly ctenoid, regular in arrangement; preopercle, subopercle, preorbital; region around eye and top of head from tip of snout back to above middle of eye naked; cheeks and opercles scaly, in the smaller examples the scales on cheeks extending on to preopercle and subopercle; dorsal spines short, flexible, of nearly uniform height, slightly shorter than soft rays; membranes of soft dorsal and anal incised; caudal forked, upper lobe longer; ventrals moderate, tips reaching within diameter of pupil of front of vent; pectoral falcate, nearly as long as head.

Color in alcohol: Reddish brown on back, becoming yellowish on belly; fins dusky.

Rocky islands of the Pacific coast from Monterey to Peru and the Galapagos Archipelago.

140. CAULOLATILUS CABEZON, new species.

FEJE-BLANCO; CABEZON; CABEZUDO.

Plate 10, fig. 3.

*Type*.—Cat. No. 77654, U.S.N.M. (field No. 09160), a specimen 27.5 cm. long, from Chimbote.

A paratype, No. 09553, 31 cm. long from Paita.

Head 2.95 in length; depth 3.2; eye 4.4 in head; snout 3; maxillary 2.64; interorbital 3.95; preorbital 5.57; pectoral 1.33; ventral 1.75; D. VIII, 23 ( $\frac{1}{2}$ ); A. I, 22; scales 14-101(+3)-35.

Body elongate, very deep at shoulders, narrowing posteriorly; caudal peduncle 3.54 in head; head long, profile strongly arched from tip of snout to origin of dorsal; mouth large, oblique; maxillary reaching to vertical from anterior border of pupil; lips fleshy; teeth small, fine, outer teeth stronger, bands of teeth widest in front, narrowing posteriorly to a single row; in the lower jaw the posterior teeth thicker, canine-like; vertical border of preopercle strongly and evenly serrate; opercle ending in a stout spine.

Scales strongly ctenoid, regular in arrangement; preopercle, subopercle, preorbital anteriorly; region around eye, snout, and top of head to above middle of eye without scales; cheeks and opercle scaly; first, second, and third dorsal spines graduated, shorter than the others, which are of about equal length, 3.7 in head, nearly as long as the anterior soft rays; twentieth and twenty-first soft rays longest, reaching to base of caudal, 2.43 in head; caudal nearly truncate, outer rays slightly produced; anal rays long as in dorsal, posterior rays

reaching base of caudal; tips of ventrals reaching vent; pectorals long, slightly falcate, tips reaching vertical from origin of anal; rays and spines all very flexible.

Color in life, a brassy green bar extending from lower side of eye forward (embracing nostril) and parallel to ventral surface of head; bars of opposite sides meeting in front, but there almost lost in the dusky color of the top of the snout; some brassy green on lower part of side of head, on iris which is mottled, and in axil of pectoral; a black spot with a slight olive tint above base of pectoral; fleshy flap on posterior margin of opercle dusky olive; fins tinted with olive.

Color in alcohol: Reddish brown, tinged with olive; opercular flap and an area above pectoral base, dusky olive; fins olivaceous.

The paratype has head 3.04 in length; depth 3.27; eye 4.35 in head; snout 2.9; maxillary 2.55; interorbital 4.04; pectoral 1.2; ventral 1.73; D. VIII, 24; A. I, 23; scales 15-101 (+4)-35. Color in alcohol, olivaceous with a tinge of reddish; belly light olive; opercular flap dark; upper base of pectoral and humeral area black.

This species may be readily distinguished from *C. princeps* by the deep head and body tapering posteriorly (in *C. princeps* the body is much more slender and more uniform); by the longer head and larger eye in specimens of same size, by the truncate form of the caudal, straighter lateral line and larger scales. It agrees with *C. anomalus* from California in having elongated dorsal spines and resembles closely Cuvier and Valenciennes' description of *Latilus chrysops* from Brazil.

### Family PINGUIPEDIDAE.

#### Genus PINGUIPES Cuvier and Valenciennes.

##### 141. PINGUIPES CHILENSIS (Molina).

##### ROLLIZO.

*Esox chilensis* MOLINA, Comp. Hist. Nat. Geo.<sup>1</sup> Civil, vol. 1, 1788, p. 394.

*Pinguipes chilensis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 9, 1833, p. 338 (457).—GAY, Hist. Chile, Zool., vol. 2, 1848, p. 165, I. Atlas, Zool. Ictiol., 1854, pl. 2, fig. 2.—VALENCIENNES, Les Poiss. Règne Anim. de Cuv., 1850, pl. 16, fig. 1.—GÜNTHER, Cat., Fish. Brit. Mus., vol. 2, 1860, p. 252.—STEINDACHNER, Fauna Chilensis, 1898, p. 301.—DELFIN, Cat. Peces de Chile, 1901, p. 82.

Two specimens, field Nos. 09716 and 09712, respectively 37.5 and 44 cm. in length, from Mollendo.

<sup>1</sup> Compendio della storia geografica, naturale, e civile del regno del Chile. 8vo. Bologna, 1776.

Head 2.96 to 3.12 in length; depth 4.25 to 4.55; eye 3.65 to 6.75 in head; snout 2.3 to 2.35; maxillary 2.2 to 2.35; interorbital 3.33 to 3.85; pectoral 1.6 to 1.68; ventrals 1.7 to 1.74; D. VI, 28; A. I, 26; scales 27-110 (+6)-37.

Body cylindrical, tapering and somewhat compressed posteriorly; greatest depth under insertion of dorsal; dorsal outline arched, ventral outline comparatively straight; head subconical, profile from tip of snout to above eyes straight; eyes small; interorbital broad and flat; mouth large, slightly oblique; lips thick and fleshy; maxillary reaching vertical from anterior border of eye; teeth in jaws in villiform bands, an outer row of strong canine-like teeth; teeth on vomer and palatines, those on front of vomer stout and blunt; jaws subequal; margin of preopercle entire; two spines on posterior border of opercle; dorsal and anal long and low; dorsal spines much shorter than soft rays; origin of ventral in front of origin of pectoral; scales small, ctenoid, regular in arrangement; cheeks and opercles scaly.

Color in alcohol: Grayish, tinged with brownish red; two rows of round white spots on each side, the first just below dorsal, the second along lateral line anteriorly, rising slightly posteriorly (only traces of these spots discernible in the larger individual); dorsal spines and anterior half of base of dorsal blackish; fins dusky; a black area on upper caudal base, above and not at end of lateral line.

Doctor Coker writes that this fish is locally known as "Rollizo," and is said to be almost the same as the "Bacalao" (cod).

### Family CIRRHITIDAE.

#### Genus CHEILODACTYLUS Lacépède.

#### 142. CHEILODACTYLUS VARIEGATUS Cuvier and Valenciennes.

#### PINTADILLA.

*Cheilodactylus variegatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 9, 1833, p. 364 (496); Valparaiso.—GAY, Hist. Chile, Zool., vol. 2, 1848, p. 199.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 357.

*Cheilodactylus cinctus* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 15, pl. 2; Peru.

*Chilodactylus variegatus* GÜNTHER, Cat. Fish. Brit. Mus., vol. 2, 1862, p. 81.—STEINDACHNER, Fauna Chilensis, vol. 2, 1898, p. 290; Herpet.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 34; Callao.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 797.

One specimen, field No. 09149, 27 cm. long, from Piscadores Island, taken by hand, floating alive on the surface, presumably sick; four, field No. 09155, 9.4-10.6 cm. long, from Ancon, taken on beach with

a seine; one, No. 09410, 20.7 cm. long, from Guanape North Island; one, No. 09572, 16.2 cm. long, from Paita; two, Nos. 09629 and 09630, respectively 16.7 and 14 cm. long, from Independencia Bay, Santa Rosa Island, east side; one, No. 514, 17.7 cm. long, from Molendo; and two, No. 278, 7.2 and 7.5 cm. long, from Lobos de Afuera, in tide pool in rocks.

Head 2.77 in length; depth 2.62; eye 5 in head; snout 2.81; maxillary 3.8; interorbital 3.8; preorbital 7.6 in head, 1.5 in eye; pectoral 1.36 in head; D. XVII, 29; A. III, 10; scales 8-58 (+3)-15.

Body compressed, rather deep, ovate; snout pointed, interorbital broad and flat; mouth small, lips fleshy; maxillary not reaching vertical from anterior border of eye; teeth in villiform bands; no teeth on vomer or palatines; dorsal spines short, stout, membranes deeply incised; soft dorsal highest anteriorly, graduated; caudal forked; anal falcate, third anal spine longest, one-third longest ray; ventrals moderate, reaching vent; six lower rays of pectoral simple, the two nearest divided rays longest, longer than divided rays.

Color in alcohol: Blackish anteriorly; five or six light crossbars from base of dorsal and on caudal peduncle, downward to ventral surface, these slightly narrower than diameter of eye. Description based on a specimen 27 cm. in length.

An individual 20.7 cm. in length, from Guanape, has head 3 in length; depth 2.63; eye 4.5 in head; snout 2.95; maxillary 4.3; interorbital 5.55; pectoral 1.3; D. XVII, 29; A. III, 9½; dorsal and anal somewhat variable; D. XVI or XVII, 29-31; A. III, 9 or 10; simple rays of pectoral 5 to 7.

Color in life of Guanape Island individuals taken from a comparison of about 20 specimens, as follows: Conspicuous color features are (1) the bright reddish-orange tips and margins of the caudal, anal, ventral, and pectoral fins; (2) about four somewhat irregular white bars, one across caudal peduncle, one extending somewhat obliquely from under anterior end of soft dorsal to anterior end of anal; belly and throat white or nearly so, showing a slight greenish tint in some specimens; the general ground color of sides and back a very dark brown, but on close examination each scale is seen to be broadly margined with dark brown, while centrally they show more or less of a light greenish or brownish gray with decided metallic luster; under surface of opercle very dark except for a broad marginal zone of dusky white; soft dorsal faintly tipped with reddish-orange.

## Family APLODACTYLIDAE.

## Genus APLODACTYLUS Cuvier and Valenciennes.

## 143. APLODACTYLUS PUNCTATUS Cuvier and Valenciennes.

## JERGUILLA.

## Plate 11. fig. 1.

*Aplodactylus punctatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 8, 1831, p. 352 (477), pl. 242; Valparaiso.—JENYNS, Zool. Voy. *Beagle*, Fish., 1842, p. 15.—GAY, Hist. Chile, Zool., vol. 2, 1848, p. 156.

*Haplodactylus punctatus* GÜNTHER, Cat. Fish. Brit. Mus., vol. 1, 1859, p. 434; *Challenger* Exp., Shore Fishes, 1880, p. 24.—DELFIN, Cat. Peces de Chile, 1901, p. 71.—STEINDACHNER, Herpet.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 80.

Two specimens, field Nos. 430 and 09723, respectively 32 and 36.5 cm. long, from Callao, and one, field No. 477, 24.5 cm. in length from Ballestas Island, region of Pisco, taken with a trammel net in 1 to 3 fathoms of water, where this species is known as "Nuñora" or "Senorita."

Head 3.72 in length; depth 2.83; eye 5.92 in head; snout 2.68; maxillary 3.32; interorbital 3.32; pectoral 1.15; ventral 1.41; D. XV—I, 20; A. III,  $9\frac{1}{2}$ ; 100 pores in the lateral line. Body stout, caudal peduncle deep, 2.18 in head; head conic; snout blunt; interorbital low, convex; eye small, high, its diameter above level of tip of snout; lips fleshy; mouth small, maxillary not reaching front of eye; teeth strong, flat, tricuspid in outer row, small cardiform teeth behind these; scales small, lateral line with a long low curve; fins scaly; dorsal spines stout; anterior rays of soft dorsal longest; caudal lunate; anal long; six lower rays of pectoral simple, thickened; first simple ray longest.

Color in alcohol: Ground color yellowish olive, everywhere dotted with small black spots, in many places the spots united to form rivulations. Described from an example 36.5 cm. long from Callao.

Specimen, field No. 477, has head 3.54 in length; depth 3; eye 5 in head; snout 2.5; interorbital 3.05; pectoral 1.14; six lower pectoral rays simple; D. XV—I, 20; A. III,  $9\frac{1}{2}$ .

The validity of *Aplodactylus reginae*, *A. vermiculatus*, and *A. guttatus* of Gay, as distinct species, is questionable, the main point of difference appearing to be one of coloration.

## Family CICHLIDAE.

## Genus AEQUIDENS Eigenmann and Bray.

## 144. AEQUIDENS RIVULATUS (Günther).

## SARRA; MAJARRA.

Plate 11, fig. 2.

*Chromis rivulata* GÜNTHER, Proc. Zool. Soc. London, 1859, p. 418.*Acara pulchra* GÜNTHER, Cat. Fish. Brit. Mus., vol. 4, 1882, p. 280.*Acara rivulata* REGAN, Fishes of the South American Cichlid genus Acara Ann. Mag. Nat. Hist., ser. 7, vol. 15, 1905, p. 338.

Five specimens, field No. 09431, and three specimens, No. 09432, 3.3 cm. to 15 cm. in length, from Pacasmayo, taken from a small dirty stream flowing through the village, and two specimens, field No. 299, 11 and 11.2 cm. long, from Eten, taken in Rio de Eten about 1 mile from its mouth. Local name of species, Majarra.

Head 2.68 to 2.8 in length; depth 2.25 to 2.55; eye 4.28 to 5.25 in head; maxillary 3 to 3.4; snout 2.1 to 2.37; pectoral 1.1 to 1.2; scales 4-26 or 27-9; D. XIV, 11 or 12; A. III, 9 or 10.

Body compressed, greatest depth at origin of dorsal; upper profile of head straight in smaller individuals, usually slightly concave in larger examples; interorbital slightly concave or flattened; maxillary not reaching vertical from front margin of eye; scales heavy, horny; posterior rays of dorsal and anal lengthened, their tips reaching in older examples nearly to the middle of the caudal.

Color in life: Gaudy with green and blue markings which fade rapidly in formalin; upper parts of head olivaceous (sides and lower parts mostly green and blue (the green changing to blue in the air); markings irregular and unsymmetrical, but a narrow stripe of bluish green extending from below eye to upper jaw, two-thirds of the way back from front of jaw, and below this stripe another parallel to it; still other spots and lines above these; ground color of body olivaceous, crossed by three to five light vertical bars, a black spot, larger than eye, about midway between opercle and caudal, below lateral line; another at base of caudal; these spots conspicuous in small examples and hardly observable in the largest; upper parts of sides, vertical fins and ventrals, spotted with blue or green; caudal and dorsal tipped with white; pectoral light olivaceous.

Some specimens were lighter than others; the smaller the fish the more distinct were the light bars.

Regarding the fishes taken at Pacasmayo, Doctor Coker writes: "These specimens were taken in a small, dirty stream flowing through the village of Pacasmayo, and conveying to the ocean the surplus water from drainage ditches fed from the Jequetepeque River. Beginning at the bay I worked up for about half a mile meeting the different kinds in the following order: 'Licitas' (young *Mugil cephalus*); 'Ancho' (*Astyanax peruanus*); 'Chorocoque' (*Lebiasina bimaculata*); 'Cameron' (shrimp); 'Sarra' (*Aequidens rivulatus*); 'Liza' (large *Mugil cephalus*). Taking fish as I came down, this order was exactly reversed."

### Family POMACENTRIDAE.

#### THE DEMOISELLES.

##### KEY TO GENERA.

- $\alpha^1$ . Teeth conical, or villiform, not compressed.....*Chromis*, p. 117.  
 $\alpha^2$ . Teeth not conical or villiform, somewhat compressed; preopercle entire in adult.  
 $\beta^1$ . Suborbitals entirely adnate to the cheeks.....*Nexilosus*, p. 121.  
 $\beta^2$ . Suborbitals not adnate to the cheeks.....*Abudefduf*, p. 123.

#### Genus CHROMIS Cuvier.

##### KEY TO SPECIES.

- $\alpha^1$ . Dorsal spines 13.....*crusma*, p. 118.  
 $\alpha^2$ . Dorsal spines 12.  
 $\beta^1$ . Caudal fin uniform in coloration.....*intercrusma*, p. 119.  
 $\beta^2$ . Caudal fin with a broad black border on each lobe, narrowly margined with lighter, central part of fin light.....*atrilobatus*, p. 117.

#### 145. CHROMIS ATRILOBATUS GILL.

*Chromis (Furcaria) atrilobata* GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 149; Cape San Lucas.

*Chromis atrilobatus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1546.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 139, pl. 21, fig. 43.

One specimen, field No. 09478, 11 cm. in length, and three specimens, field No. 09440, 5.7 to 7.5 cm. in length, from Lobos de Afuera.

Head 3.36 in length; depth 2.62; eye 3.57 in head; snout 3.84; maxillary 2.77; D. XII, 13; A. II, 10 (normally there are 11 or 12 rays in the anal); scales 3-28-9, 20 pores.

Body slender, greatest depth at origin of dorsal; a slight depression over eye in longitudinal contour; top of head everywhere transversely convex; preopercle oblique, sometimes slightly emarginate in its lower half, mouth small, oblique; teeth in bands in each jaw, those in the outer row large, conical, curved; spinous dorsal low, of uniform height; soft dorsal and anal angulated; caudal lobes long, pro-

duced into filaments, fin deeply forked; ventrals moderate, in some specimens with the first ray filiform; pectoral long and angulated, equal to or greater than length of head.

Color in life: Olivaceous above; below bluish silvery, and very obscurely striped; a pale spot (gold when first taken) on back at posterior limit of dorsal, the spots of the two sides confluent posteriorly behind dorsal; a broad black stripe extending from insertion of each lobe of caudal to its slender tip; just above dorsal stripe and just below ventral stripe the fin is very narrowly margined with pink; between the stripes the fin is olivaceous proximally and pink posteriorly; dorsal almost black, a small part including last two to four rays olivaceous proximally and reddish distally; distal half of anal light olive, pectoral reddish at base, insertion black.

This species occurs from Cape San Lucas southward to Lobos de Afuera, Peru. It is reported to be very abundant about the islands in Panama Bay; not recorded from the Galapagos Islands.

146. *CHROMIS CRUSMA* (Cuvier and Valenciennes).

*CHAVELITA; JUNICHE; CONGUYO.*

*Helias crusma* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 9, 1833, p. 377 (510), (part); Valparaiso, Chile (specimen from Juan Fernandez Island not this species.—JENYNS, Zool. Voy. *Beagle*, 1842, p. 54.—GAY, Hist. Chile, Zool., vol. 2, 1848, p. 206 (part), I, Atlas Zool. Ictiol., 1854, pl. 4, fig. 1.—VALENCIENNES, Poiss. Règne Anim. de Cuv., 1850, pl. 33, fig. 2.

*Helias crusma* GÜNTHER, Cat. Fish Brit. Mus., vol. 4, 1862, p. 61.—STEINDACHNER, Fauna Chilensis, vol. 4, 1898, p. 317.

*Chromis crusma* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 358.—DELFIN, Cat. Peces de Chile, 1901, p. 76.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 798.

Two specimens, field Nos. 508 and 515, respectively 17.5 and 14 cm. long, from Mollendo; one, field No. 09144, 15.1 cm. long from Callao; and seven, field No. 09627, 4.2 to 13 cm. long from Independencia Bay, Santa Rosa Island, east side.

Head 2.95 in length; depth 2.03; eye 3.66 in head; snout 4; interorbital 3.1; scales  $3\frac{1}{2}$ –27–10, 20 pores; D. XIII, 12; A. II, 12; P. 20.

Body short, deep ovate and rather thick, the dorsal outline slightly more convex than the ventral; snout short and abruptly conic, shorter than eye; interorbital rounded; opercle, preopercle and suborbital entire; preopercular margin varying considerably, in some specimens the free sides nearly straight, closely approaching a right angle, in others the vertical portion strongly concave; opercle ending in two small flat spines, the upper obscure; teeth conic, in three or four rows in each jaw, the outer series enlarged, close-set; third dorsal spine

longest, 2.13 in head; soft dorsal considerably higher than spinous portion, rather acute, the middle rays elongate, longest rays 1.65; second anal spine long and stout, 1.94, anal rounded, not so acute as soft dorsal, longest rays 1.86; caudal deeply emarginate, the upper lobe slightly longer than lower, equal to head in length; ventrals elongate, reaching past vent and in some specimens to base of anal, 1.35; pectoral broad, longer than head .9 in head; scales large, regular, strongly ctenoid, densely covering entire body and head except anterior border of snout; lateral line well developed, arched, following contour of back to within two scales of base of dorsal, where it ceases; fins scaled at base, those on spinous dorsal largest.

Color in alcohol, bluish black on back, scales on sides with a central area of silver, margin dusky; approaching the ventral surface, the silver area increasing in size until it covers all of the scale except a narrow marginal line; scales more or less punctulate with dusky; dorsal blackish; caudal dusky white; anal blackish; ventral blackish, mottled with light; pectoral silvery translucent, base iridescent bluish, darkest in upper angle. Description based chiefly on a specimen 17.5 cm. long from Mollendo.

The individuals from Santa Rosa Island are dark brown, quite uniform in coloration, but showing some traces of the silvery central areas to scales in places; caudal and pectoral darker; iridescent blue base of pectoral very distinct.

Color in life of field No. 09144, back and sides dusky above, sides lighter; scales with dusky margin, light within; belly and lower part of sides silvery; membrane between rays of pectoral very transparent; some specimens much lighter than others.

This species is known under a considerable number of common names; our specimens from Callao were called "Chavelita"; at Santa Rosa, "Conguyo"; at Mollendo, "Juniche." Abbott records individuals from Callao under the names "Cognito" or "Conquito," and Delfin states that the names "Castaneta," "Boquilla," "Frailecito" and "Pampanito" are applied to this species by fishermen on the coasts of Peru and Chile.

147. *CHROMIS INTERCRUSMA*, new species.

*CHAVELITA*.

Plate 11, fig. 3.

*Hemias crusma* CUVIER and VALENCIENNES (part), Hist. Nat. Poiss., vol. 9, 1833, p. 377 (510); Juan Fernandez Island (not the types from Valparaiso).—GAY, Hist. Chile, Zool., vol. 2, 1848, p. 206 (part).

*Type*.—Cat. No. 77590 U.S.N.M. (field No. 09403), a specimen 15 cm. long from Guanape North Island.

One specimen, field No. 09457, 13.1 cm long, and three specimens, field No. 09445, 7.8 to 8.7 cm. long, from Lobos de Afuera.

Cuvier and Valenciennes base their description of the species *Heliasces crusma* upon two individuals  $5\frac{1}{2}$  inches long from Valparaiso, Chile, and include an individual 8 inches long from Juan Fernandez Island, indicating certain differences between this example and those from Valparaiso. Specimens in our collection from Mollendo, Callao, and Santa Rosa Island agree very well with their description of the Valparaiso examples; other specimens in our collection taken at Guanape and Lobos de Afuera present certain of the differences indicated in their example from Juan Fernandez Island and possess other characters which serve to definitely separate the latter as a distinct species, to which we have given the name *Chromis intercrusma*.

The type (field No. 09403) from Guanape North Island has the following comparative measurements: Head 3.2 in length; depth 2.15; eye 3.9 in head; snout 4; maxillary 3.04; D. XII, 14; A. II, 14; P. 20; scales  $3\frac{1}{2}$ -27-10, 20 pores.

Body short, deep, ovate, and compressed, the curvature of the dorsal and ventral outlines nearly equal; snout short, conical, shorter than eye; interorbital rounded, with a slight depression in center; teeth conic, in three or four interrupted rows, those in outer row slightly larger than others; opercle, preopercle, and suborbital entire; vertical border of preopercle nearly straight, the angle rounded; opercle ending in two flat, rather obscure spines; fourth to sixth dorsal spines longest, equal in length, 2.4 in head; middle rays of soft dorsal longest, acute, longest ray 1.75 in head; caudal forked, upper lobe slightly the longer, longer than head, 0.87; second anal spine moderate, 2.12; soft anal acute or slightly rounded posteriorly, longest ray 1.92; ventrals moderate, reaching to behind vent, 1.4; pectoral rounded, shorter than head, 1.09; scales large, regular, close-set, ctenoid, covering all of body and head except snout and tip of lower jaw; those on upper surface of head, around eye, on cheeks and under surface of head, small and crowded.

Color in alcohol, brown, centers of scales dark brown, marginal half lighter on those below the lateral line, the separation of the two colors most distinct ventrally; dorsal, anal, and ventrals very dark brown; caudal dusky brown, inner margin of lobes lighter; pectoral tawny, base dark brown, darkest in upper angle; a trace of blue iridescence near posterior border of opercle.

A paratype (field No. 09457) has the following comparative measurements: Head 3.16 in length; depth 2.06; eye 3.33 in head; snout 4.2; interorbital 3; pectoral 1; D. XII, 14; A. II, 13; scales  $3\frac{1}{2}$ -27-10. Coloration like that of the type but darker.

Color in life of a paratype (field No. 09445): Dusky bluish; a black spot in axil of pectoral.

This species is easily distinguished from *Chromis crusma* by the shorter head, shorter pectoral (in this species it is equal to or less than head; in *crusma*, it is always longer than the head); by the differences in the fin formulas of dorsal and anal and by the slenderer, more compressed body, especially anteriorly.

Cuvier and Valenciennes note that the example from Juan Fernandez differed from the others in having the vertical border of the preopercle straight instead of concave and the angle more acute, the upper lobe of the caudal longer and more pointed, causing the forking of the fin to appear deeper. These characters do not appear to be of specific importance in separating this species. In our examples of each species the straightness of the vertical border of the preopercle varies, as does the forking of the caudal lobes. This species is found in the vicinity of the small island groups on the coasts of Peru and Chile.

### Genus NEXILOSUS Heller and Snodgrass.

#### 148. NEXILOSUS LATIFRONS (Tschudi).

##### CASTANETA; SARGO DE PENA.

*Pomacentrus latifrons* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 17;

Huacho, Peru.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 4, 1862, p. 34.

*Glyphidodon latifrons* STEINDACHNER, Fauna Chilensis, 1898, p. 316.

*Eupomacentrus latifrons* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 358.

*Abudefduf latifrons* DELFIN, Cat. Peces de Chile, 1901, p. 75.

*Nexilosus albemarleus* HELLER and SNODGRASS, Proc. Washington Acad. Sci., vol. 5, pl. 8, 1903, p. 204; Albermarle Island.—SNODGRASS and HELLER, Shore Fishes of the Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 391.

One specimen, field No. 509, 20.3 cm. in length from Mollendo; two, field Nos. 09171–2, respectively 19 and 14.6 cm. in length, from Guanape North Island; one, field No. 09443, 13.4 cm. in length, and three young examples, field No. 278, 2 cm. in length, from Lobos de Afuera (the small individuals taken from a small tidal pool).

Head 3.2 (4 total) in length; depth 1.97 (2.5); eye 4.9 in head, 1.9 in snout, 2.2 in distance between lower edge of orbit and lower edge of preopercle; preorbital 1.11 in eye; snout 2.5 in head; D. XIII, 18; A. II, 14; scales 4–27–12, 22 pores.

Body ovate, deep, rather thick, curvature of dorsal outline greater and more regular than that of the ventral outline; snout moderate, blunt; mouth small, nearly horizontal, lips thick; teeth well developed, in a single series, compressed at tips, entire, incisor-like; nostril very small, slightly above lower level of orbit; suborbital adnate to cheek, lower free portion distinct; vertical border of preopercle nearly straight, the lower border rounded; opercle ending in

a single flat spine, above which in the upper angle are two others, indistinct.

Spinous dorsal low, upper outline sinuous, fifth spine longest, 2.7 in head; soft dorsal much higher, acute, the posterior rays shorter than the anterior, longest ray 1.44; caudal deeply forked, the lobes large and round, of which the upper is considerably longer, equal to length of head; anal spines small, the second the longer, 3 in head, middle rays of anal longest, 1.7 in head; depth of caudal peduncle 1.88; ventrals moderate, reaching to behind anus, 1.16; pectoral broad, upper rays longest, 1.09 in head; scales large, regular, densely covering body and head except snout in front of eyes, area around mouth, and lower margin of preopercle; scales along middle of side largest, most of them with accessory scale at base, those above lateral line most numerous; fins densely scaled, those on spinous dorsal concealing all but tips of spines.

Coloration in life: Back and sides a very dark brownish olive, each scale with a very dark margin, lighter centrally; a bright bar of dusky gold extending incompletely across body a short distance before anterior end of anal; fleshy flaps margining opercle very dark; soft parts of fins black; throat and lower parts of head a light chestnut brown. Description based on a specimen (field No. 509) 20.3 cm. long, from Mollendo.

Color in life of a specimen (field No. 09172) 14.6 cm. long, from Guanape North Island, general color dark olive green, lightened by the golden bar and the metallic greenish centers of the scales, the greenish centers giving place in some parts, especially anteriorly, to bluish or violet; lower part of head and throat tinted purple.

In alcohol, the individuals from Guanape and Lobos de Afuera are much darker (almost a bluish black) than the one from Mollendo, the latter having a decided brownish cast.

The three small examples (No. 278) taken in a tidal pool in the rocks were in life brilliant blue in color; in the water, the general color of darker blue varied by shining spots of lighter blue. They have D. XIII, 18 or 19; A. II, 14; scales 4-28-12; preopercle strongly serrate; top of head and region around mouth to below anterior margin of pupil without scales.

From a study of the young it is evident that the genus *Nexilosus* is very close to *Pomacentrus*, differing in the adnate condition of the suborbital, a condition which appears to be approached by some of the young of this genus.

The only previous records of this species are those of Tschudi who obtained a few examples, 9 inches long, from Huacho, Peru; two large examples, 21.9 and 22.5 cm. long obtained by Doctor Plate at Cavanha Bai near Iquique and described by Steindachner, and several specimens obtained by Heller and Snodgrass at Tagus

Cove, Elizabeth Bay and Iguana Cove, Albemarle, Galapagos Islands. The latter have an excellent figure and description of the species under the name of *Nezilodus albemarleus*.

### Genus ABUDEFDUF Förskal.

#### 149. ABUDEFDUF SAXATILIS (Linnaeus).

*Chaetodon saxatilis* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 276.

*Abudefduf saxatilis* JORDAN, Fishes of Sinaloa, Proc. California Acad. Sci., ser. 2, vol. 5, 1895, p. 475.—JORDAN and EVERMANN, Fishes of North and Mid. Amer., vol. 2, 1898, p. 1561; vol. 4, 1900, pl. 234, fig. 590.

*Glyphisodon saxatilis* GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 143.

*Abudefduf marginatus* SNODGRASS and HELLER, Shore Fishes of the Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 390.

One specimen, field No. 278 (part), 5.7 cm. long from Lobos de Afuera, taken from a very small shallow tide pool in the rocks.

Head 3 in length; depth 2.04; eye 2.72 in head; snout 3.33; maxillary 3.33; P. 1.15; V. 1.52; scales  $4\frac{1}{2}$ -27-11; D. XIII, 14; A. II, 13.

This specimen is small and badly distorted.

### Family LABRIDAE.

#### THE WRASSE FISHES.

##### KEY TO GENERA.

- $\alpha^1$ . Vertebrae 27 to 29 (so far as known); dorsal spines 11 to 13; sides of head more or less scaly.
- $b^1$ . Scales large, 5-33 to 35-12-----*Bodianus*, p. 123.
- $b^2$ . Scales small, 9-52 to 55-20-----*Pimelometopon*, p. 127.
- $\alpha^2$ . Vertebrae 23 to 26; dorsal spines 8 to 9; head mostly naked.
- Halichoeres*, p. 128.

### Genus BODIANUS Bloch.

##### KEY TO SPECIES.

- $\alpha^1$ . Color in life not red; pale blue, with a yellow patch behind the pectoral fin, which has a large dark spot on its extremity; head, tail and fins bright red, their tips black and yellow; forehead very gibbous in the adult; depth 3 to 3.5. Female brownish yellow; a dark band commences behind the snout and is divided into two behind the eye, the upper portion running along the back and nearly joining its fellow from the other side on the back of the free portion of the tail, while the lower crosses the angle of the operculum, and is continued on to the middle of the tail, terminating near the caudal and alternating with two spots behind the base of the caudal fin; fins yellowish or orange. Forehead scarcely gibbous in the adult-----*diplotaenius*, p. 124.
- $\alpha^2$ . Color chiefly red or black, without dark bands or stripes; body without dark crossbands or stripes; general color vermillion, with two large, irregular, black blotches on the back and dorsal fin, the anterior on the first six dorsal spines, the posterior extending over the whole soft dorsal and over a portion of the back of the tail; snout pointed, with upper profile slightly concave; head longer than high; caudal emarginate-----*eclancheri*, p. 125.

159. *BODIANUS DIPLOTAENIUS* (GILL).

GALLO.

*Harpe diplotaenia* GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 140; Cape San Lucas.—JORDAN, Fishes of Sinaloa, Proc. California Acad. Sci., ser. 2, vol. 5, 1895, p. 480.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1582.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 144.

*Bodianus diplotaenius* SNODGRASS and HELLER, Shore Fishes of the Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 391.

Two specimens, field Nos. 09439 and 09683, respectively 17.5 and 34 cm. long, from Lobos de Afuera.

Head 3.03 in length; depth 2.93; eye 6.35 in head; snout 2.4; interorbital 3.42; pectoral 1.53; ventral 1.64; D. XII, 11; A. III, 13; scales 5-33-12.

Body compressed; head short; snout concave, becoming convex over eyes; fleshy pad on forehead little developed; mouth moderate, maxillary scarcely reaching vertical from front of eye; lips fleshy, lower lip with a flap on each side; upper jaw with four long, strong, pointed canines in front; behind these small granular teeth, somewhat coalescent and forming a single row posteriorly, those at back of jaws enlarged, canine-like; at extreme posterior end a long pointed canine tooth, bent forward; teeth of lower jaw similar, irregular, no canine at posterior end of jaw; vertical border of preopercle with fine denticulations; dorsal spines low, strong, covered with membrane, membranes incised nearly to base of fins, a rounded fleshy flap covering the spines extending for some distance beyond the tips of the spines; middle rays of dorsal filamentous 1.5 in head; caudal lunate; anal similar to soft dorsal; ventrals moderate, not reaching vent; pectoral short and broad; pectoral base a little in advance of ventrals; scales large, regular in arrangement, dorsals and anal sheathed; top of head, snout, and oral region scaleless; cheeks and opercles scaly.

Color in alcohol, olivaceous, scales margined with brown; a dark brown band extending from tip of snout through eye, where it divides into two bands, the upper extending obliquely upward and backward to dorsal surface of caudal peduncle, where it is joined with its fellow by two dark-brown saddles; the second horizontal and ending on caudal peduncle, not to base of caudal; these bands not continuous but interrupted, formed by a series of rectangular dark-brown blotches, most distinct posteriorly; on the base of the caudal, above and below the lateral line, are two rectangular brown areas; top of head mottled; vertical fins brown and yellow; ventrals dusky yellow; pectoral yellow, tipped with black. Description based on an individual 34 cm. long, from Lobos de Afuera. Color in life: Of graceful form and delicate blend of colors. Poste-

rior margins of scales olive green, centers light and tinted red; two black stripes of somewhat irregular outline on sides ( $\frac{1}{4}$  cm. wide in specimen 18.5 cm. long), the lower extending from lower part of eye to a point halfway between posterior limit of dorsal and anal and the posterior limit of scales on the caudal; the other from middle of eye upwards a little and then parallel to the other stripe and at a distance from it of 1 cm. to dorsal margin of peduncle; two black spots on scaly part of base of caudal placed symmetrically above and below lateral line; usually an orange spot between end of stripe and the black spot; dorsal, proximal, and ventral parts of caudal reddish, otherwise tinted with gold; dorsal and anal fin rays large-tipped with blue and purple; extreme posterior parts of both fins below longest fin rays with mixed red and gold; pectoral reddish; ventrals purplish; iris golden posteriorly, red anteriorly; skin covering jaws red posteriorly.

The coloration and form of this species are subject to considerable variation. In the adult male there is a large fleshy pad on the forehead, this often reaching a height of several times the diameter of the eye; this pad said to be much less pronounced in the female. In the young the snout is pointed and the caudal truncate.

This species occurs along the coast of tropical America, Galapagos Island southward to Peru.

151. *BODIANUS ECLANCHERI* (Valenciennes).

VIEJA NEGRA.

*Cossyphus eclancheri* VALENCIENNES, Voy. *Venus*, Zool., Poiss., 1855, p. 340, pl. 8, fig. 2, 1846; Galapagos Islands.

*Harpe eclancheri* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1588.

*Bodianus eclancheri* SNODGRASS and HELLER, Shore Fishes of Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 392.—KENDALL and RADCLIFFE, Mem. Mus. Comp. Zool., pl. 35, No. 8, April, 1912, p. 137; Wreck Bay, Chatham Island.

Two specimens, field Nos. 09442 and 09452, respectively 26 and 21.3 cm. long, and three, field Nos. 09461-3 (heads only), from Lobos de Afuera.

Head 2.9 in length; depth 2.38; eye 6.16 in head; snout 2.96; maxillary 3.36; interorbital 3.36; pectoral 1.37; ventrals 1.82; D. XIII, 11; A. III, 12; scales 5-35-12.

Body short and deep; head longer than high; snout pointed; slight trace of fleshy pad of adipose tissue on forehead; teeth essentially the same as in *B. diplotaenius*; canines compressed, stout; preopercle serrulate; cheeks, opercle, subopercle and interopercle scaly; preopercle naked; scaling and shape of fins essentially as in *B. diplotaenius*.

*taenioides*. In the specimen here described the ventrals are filamentous, reaching to vent; longest dorsal ray 1.76 in head; longest anal ray 1.85.

Color in alcohol bluish black.

This description is based on a specimen 26 cm. long, from Lobos de Afuera.

Another example 21.3 cm. long, had the following measurements: Head 3.16 in length; depth 2.37; eye 5.4 in head; snout 3; inter-orbital 3; pectoral 1.12; ventrals 1.35; longest dorsal ray 1.42; longest anal ray 1.58; D. XII, 11; A. III, 12; scales 5-35-12.

Field No. 09461, of which only a portion of the head was saved, must have been a much larger fish. In it the adipose tissue on forehead is well developed, its height 1.4 in length of snout; two of the canines in upper jaw are much compressed and hollowed out on the under side; jaws behind canines with 7 or 8 short, blunt, teeth, a single stout tooth on posterior end of left side, three on the right side, the anterior of these being the longer.

Color in life of these specimens, almost black with some bluish mottlings; under side of head bluish. In some specimens at least a black bar passes from eye to eye over the head just back of the lump. The only bright color is seen in the iris, which is a mixture of gold and dusky.

Regarding the use of the names "vieja," "negra," "jobero," etc., Doctor Coker writes: "The 'negra' is applied only to small and perfectly black specimens. Larger black specimens are called 'vieja' or 'vieja negra.' The 'jobero' or 'hobero' seems to be the same species, but the name applies only to specimens of a brilliant orange or yellow or white, or partly of one of those colors. 'Vieja colorado' is applied to large red or brown specimens. I am not sure that this name is not sometimes applied to the 'mulata,' a related fish sometimes of variable color, sometimes red, but with smaller scales (50 or more in lateral line as compared with about 30 in lateral line of 'vieja'). The 'jobero' may be white (unpigmented) in parts or over the entire body, when it presents a striking washed-out appearance. The color variation in 'viejas' and 'joberos' is remarkable. One part of the body may be dark red, brown, or jet black, while another part is bright yellow, orange, or white. The two colors will be separated by the sharpest sort of line, though their distribution may be entirely irregular and unsymmetrical. Thus a fish with general color of dark reddish brown may have a pure white head, the unpigmented area extending much farther back on one side than on the other. The 'gallo' has a characteristic color pattern."

From the above description it is evident that the same wide range of color variation occurs here as is recorded in specimens from the

Galapagos Islands. A comparison of the various common names with the identified specimens in our collection indicates that the term "vieja negra" is applied to the black variety of this species, "vieja colorado" to *Pimelometopon darwini*; "gallo" to *Bodianus diplotaenius*; "mulata" to both *B. diplotaenius* and *P. darwini*.

Although the only representatives of *B. eclancheri* in our collection are of the black variety, it is evident that the name "jobero" applies to specimens of this species having a more brilliant coloration, yellow, orange, or white and black, or combinations of these colors.

### Genus PIMELOMETOPON Gill.

#### 152. PIMELOMETOPON DARWINII (Jenyns).

##### MULATA; VIEJA COLORADO.

*Pimelometopon canis* (PHILIPPI), included by Abbott in his list of Marine Fishes of Peru, has been recorded from Iquique and may occur on the Peruvian coast.

*Cossyphus darwini* JENYNS, Voy. *Beagle*, Fishes, 1842, p. 100, pl. 20; Chatham Island.

*Labrus asper* VALENCIENNES, Voy. *Vénus*, Poiss., 1855, p. 338, pl. 8, fig. 1.  
*Trochocopus darwini* GÜNTHER, Cat. Fish. Brit. Mus., vol. 4, 1862, p. 100.—STEINDACHNER, Fauna Chilensis, 1898, p. 317.

*Pimelometopon darwini* GILL, Proc. Acad. Nat. Sci. Phila., 1864, p. 59.—JORDAN and EVERMANN, Fishes of North and Mid. Amer., vol. 2, 1898, p. 1586.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 359.—SNODGRASS and HELLER, Shore Fishes of the Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 394.

Four specimens, field Nos. 09465-6 and 09678-9, respectively 25.5, 31.7, 25, and 32 cm. long, from Lobos de Afuera. Field Nos. 09465-6 were taken on the west side of westward islands. One specimen, field No. 507, 26 cm. long, from Mollendo.

The genus *Pimelometopon* is close to *Trochocopus* of Günther, but differs in the possession of a greater number of scales and a serrulate preopercle (at least in the young), a character not noted in earlier descriptions.

Head 2.75 in length; depth 2.98; eye 6.06 in head; snout 2.34; interorbital 3.5; pectoral 1.57; D. XII, 10; A. III, 12; scales 9-52-20.

Body deep, compressed; head large; snout pointed, its contour straight; gape of mouth extending to vertical from anterior border of eye; lips fleshy, lower jaw with a flap on sides as in *Bodianus*, with which it agrees also in the character of the teeth; eye small, about half width of interorbital; margin of preopercle with fine serrulations; fins essentially as in *Bodianus*; scales smaller.

Color in alcohol, olivaceous; a large light olive area on side above pectoral; a large black blotch covering first three dorsal spines. Description based on a specimen 32 cm. long, from Lobos de Afuera.

Our only example from Mollendo has the following measurements: Head 2.77 in length; depth 2.92; eye 6.5 in head; snout 2.6; interorbital 3.22; pectoral 1.56; D. XII, 10; A. III, 12; scales 9-54-20.

This individual is olive yellow in spirits and the blotch on front of dorsal is black.

According to Dr. R. E. Coker, this species shows remarkable color variation in life, and doubtless individual specimens are subject to marked changes of color. Some, like No. 09465, are flaming red; others, as No. 09466, are of a somber chocolate color with a reddish tinge only in places; underside of head dusky, except region of lower lip which is white; small olive spots more or less noticeable on top of head; caudal, centrally and distally, olive tinted.

Steindachner's statement, in *Fauna Chilensis*, that the formula for the transverse rows of scales is 8/1/9 is evidently an error and should be read 8/1/19.

### Genus HALICHOERES Rüppell.

#### 153. HALICHOERES DISPILUS (Günther).

##### SAN PEDRANO; DONCELLA.

*Platyglossus dispilus* GÜNTHER, Proc. Zool. Soc. London, 1864, p. 25; Panama.

*Halichoeres dispilus* JORDAN, Fishes of Sinaloa, Proc. California Acad. Sci., 2, vol. 5, 1895, p. 481, pl. 45; Panama.

*Iridio dispilus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1597.

One specimen, field No. 423, 19.8 cm. long, from Callao, near San Lorenzo Island; one, field No. 09631, 16 cm. long, from Independencia Bay, Santa Rosa Island; and one, field No. 09488, 18.3 cm. long, and two, field No. 09499, 8.8 and 15.2 cm. long, from Lobos de Afuera.

Head 3.18 to 3.37 in length; depth 3.5 to 3.6; eye 6.3 to 7.3 in head; snout 3 to 3.2; interorbital 4.4 to 4.9; pectoral 1.4 to 1.44; D. IX, 11½; A. III, 12; scales 2½-27-9.

Body slender, compressed; curvature of dorsal and ventral outlines similar; greatest depth of body under fourth dorsal spine; head moderate, snout pointed; eye small, about 2 in interorbital; mouth small, jaws subequal, lips fleshy; four strong canines in front of each jaw followed by a single row of smaller teeth; a strong canine at posterior end of upper jaw, its tip directed forward; dorsal spines short, flexible, their tips barely projecting beyond the membrane; posterior rays of dorsal longest, about 2.75 in head; caudal double-concave; anal similar to soft dorsal; ventrals small, tips reaching halfway from base to origin or anal; pectoral short and broad.

Scales large, regular in arrangement; head without scales; a line in front of dorsal along median line of back not crossed by the scales; lateral line arched, following contour of back.

Color in alcohol, olivaceous or yellow tinged with red; a large black area under fourth dorsal spine, crossing lateral line, more pronounced below line; black area confined to center of scales, margins lighter; two individuals with a distinct black notch at base of caudal; a black area on opercle; fins body color; sides of head with 4 or 5 wavy bands, these indistinct or absent in these individuals.

Pacific coast of tropical America, Mazatlan to Peru.

### Family SCARIDAE.

#### THE PARROTFISHES.

#### Genus XENOSCARUS, new genus.

*Type of genus.*—*Xenoscarus denticulatus*. Jaws subequal, the lower barely included; gill membranes narrowly joined to the isthmus, across which they form a broad fold; upper lip double for its entire length; lateral line continuous; one row of scales on cheek; teeth white, distinct, imbricated in regular oblique rows in both jaws, wholly concealing the dental plates to the anterior edge of which they are affixed; cutting edge of each jaw formed by the outer teeth, the dental plate not reaching the edge, and visible only from within; dorsal spines IX, soft and flexible; base of dorsal and anal with scaly sheath.

This genus is related to *Calotomus* in the character of the teeth and flexibility of dorsal spines, but differs from it in having the upper lip double for its entire length, in this respect agreeing with *Sparisoma*, and in having the gill membranes forming a broad fold across the isthmus. From *Scaricthys* Bleeker, it differs in having the teeth distinct.

(*ξενος*, strange; *σκαπος*, Scarus, the ancient name of *Sparisoma cretense*).

#### 154. XENOSCARUS DENTICULATUS, new species.

#### POCOCHO DE MAR.

Plate 12, fig. 1.

*Type.*—Cat. No. 77619, U.S.N.M., a specimen 25 cm. in length (field No. 09474), and paratype field No. 09500, 24.1 cm. in length, from Lobos de Afeura.

Head 3.16 in length; depth 3; eye 5.66 in head; snout 2.5; interorbital 3.4; pectoral 1.69; ventral 1.91; D. IX, 10; A. III, 9; scales  $1\frac{1}{2}$ –25–6 ( $5\frac{1}{2}$ ).

Interorbital broad, flat, raised but little above upper edge of orbit; dorsal outline of head nearly straight; dorsal and ventral

outlines evenly convex; eye small; snout blunt; jaws subequal, the lower slightly included. Teeth white, free, convex, incisorlike, those in the upper jaw arranged in five oblique rows, extending upward and backward, those in front of jaw slightly irregular in arrangement, those in lower jaw in about six oblique rows extending downward and backward, these rows not having a common starting point at the symphysis, being arranged along the sides of the dental plate; no canines; upper lip double for its entire length; lips nearly covering teeth. Scales large, thin, their edges membranous; four scales on median line of back, in front of dorsal; cheek with a single row of four scales; lateral line continuous, pores numerous and widely branched; base of dorsal and anal with scaly sheath. Dorsal spines flexible, the membranous covering of spines extending into a long filament, those posteriorly becoming shorter; caudal rounded, its lower rays somewhat shortened; pectoral rounded, upper divided rays equaling middle rays in length.

Color in spirits: Slaty gray; scales on the sides and belly with a brownish tinge in the center and a lighter margin; dorsal, caudal, and anal dusky, mottled with indistinct round spots; ventrals body color; pectoral slightly lighter.

Color of specimens freshly dead, chiefly dark green above, lighter below, with a tinge of red on throat, belly, and lower part of sides, and also on the distal part of ventrals.

Comparative measurements of the paratype: Head 3.15 in length; depth 3; eye 5.54 in head; snout 2.55; interorbital 3.32; pectoral 1.66; ventral 1.84; D. IX, 10; A. III, 9; scales  $1\frac{1}{2}$ -25-6.

This individual has more of a brownish wash; soft dorsal membranes dusky translucent; rays with alternating brown and light areas; caudal brown with round white dots, which are smaller than eye; anal dusky; ventrals slaty; pectoral rays brownish, membranes translucent.

## Family BALISTIDAE.

### THE TRIGGERFISHES.

#### KEY TO GENERA.

- a<sup>1</sup>. Gill opening with a number of enlarged bony plates or scutes behind it; ventral flap movable, supported by a series of spines, more or less free at tip, and resembling fin rays; cheek entirely scaled, without naked grooves or patches; eye with a groove before it; scales rather small, 50 to 75  
-----*Balistes*, p. 131.
- a<sup>2</sup>. Gill opening with only ordinary scales behind it; no enlarged plates or scutes; ventral flap scarcely movable, its surface scaled; lateral line obsolete; third dorsal spine small or wanting; vertical fins in adult more or less angulate or falcate-----*Canthidermis*, p. 131.

Genus **BALISTES** (Artedi) Linnaeus.155. **BALISTES POLYLEPIS** Steindachner.**PEJE-CHANCRO.**

Plate 12, fig. 2.

*Balistes polylepis* STEINDACHNER, Ichth. Beitr., vol. 5, 1876, p. 21, Magdalena Bay; Mazatlan; Acapulco.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1900.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 152.

One specimen, field No. 09472, 45 cm. long, from Lobos de Afuera, taken by fishermen in about 25 fathoms.

Head to lower end of gill slit 3.4 in length; depth 1.8; eye 5.2; snout 1.25; interorbital 2.5; pectoral 2; first dorsal spine 1.44; longest dorsal ray 1.13; longest anal ray 1.35; upper caudal ray longest, 0.95; D. III-26; A. 24; oblique rows of scales, counted downward and backward, 65, counted downward and forward, 75; scales from origin of dorsal to anal origin, 50; preocular groove prominent.

Body short and deep, dorsal and ventral outlines strongly arched; caudal peduncle slender, unarmed, its least depth 3.5 in head; upper profile of head very slightly convex; eye small, high, within  $1\frac{1}{2}$  diameters of origin of dorsal; eight strong teeth in each jaw; a strong groove in front of eye, its length greater than diameter of eye; plates behind gill-opening large; dorsal fin high, falcate; outer rays of caudal greatly produced, fin concave; anal triangular, anterior rays longest; pectorals small.

Color in alcohol, olive brown, darkest on back; fins dusky.

This species differs from *B. naufragium* in having 64 rows of scales counted downward and backward instead of 46 to 50; in having the preocular groove much more prominent; the small tubercle on scales less prominent; the dorsal more falcate; the caudal lobes longer; the middle rays less produced; and the coloration plainer.

Specimens from Guadalupe Island, Mazatlan, and Panama Bay have 27 or 28 dorsal and 25 or 26 anal rays. Gilbert and Starks state that the lower caudal lobe is shorter in the specimens from Panama; in our specimen the opposite is true.

Genus **CANTHIDERMIS** Swainson.156. **CANTHIDERMIS ADSPERSUS** (Tschudi).

*Balistes adpersus* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 31; Huacho.—

ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 360.

?*Canthidermis angulosus* SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 407.

*Canthidermis angulosus* KENDALL and RADCLIFFE, Shore Fishes, Agassiz-Albatross Eastern Pacific Expedition, Mem. Mus. Comp. Zool., vol. 35, No. 3, April, 1912, p. 164.

In Shore Fishes of the Galapagos Island (p. 407), Snodgrass and Heller describe a large example of *C. angulosus* from Cocos Island

which was unspotted. Kendall and Radcliffe, in *Shore Fishes, Albatross Eastern Tropical Pacific Expedition* (p. 164), list three very small individuals as *C. angulosus*, from station 4619, off the coast of Panama, and state that *Balistes adspersus* of Tschudi is probably the same species. These small individuals had the sides of the body dotted with small, round, white spots. The type of *Canthidermis angulosus* (Quoy and Gaimard) came from the Hawaiian Islands.

If the form found on the Pacific coast of America is found to be different from the Hawaiian species, as seems highly probable, the former would become *C. adspersus*.

For the present we have provisionally adopted this name.

The largest individual taken off the coast of Panama, 21 mm. in length, has the following measurements: Head 2.57 in length; depth 1.63; eye 3.5 in head; snout 2; pectoral 1.55; first dorsal spine 1.4; height soft dorsal 2; D. III-21; A. 20; P. 13; scales about 45; soft dorsal, anal and caudal rounded; body dark brown with numerous small, round white spots; fins yellowish.

## Family TETRAODONTIDAE.

### THE PUFFERS.

#### Genus SPHEROIDES Lacépède.

#### 157. SPHEROIDES ANNULATUS (Jenyns).

#### FEJE-SAFO; TAMBORIN.

*Tetrodon annulatus* JENYNS, Zool. Voy. *Beagle*, 1842, p. 153; Chatham Island.—STEINDACHNER, Ichth. Beitr., vol. 5, 1876, p. 23; Herpet-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 60; Guyaquil.

*Anchisomus geometricus* (Kaup) RICHARDSON, *Voyage Herald*, 1854, p. 156, pl. 30; Galapagos Islands; not of Bloch and Schneider.

*Spheroides annulatus* JORDAN and EVERMANN, *Fishes of North and Mid. Amer.*, 1898, vol. 2, p. 1735.—GILBERT and STARKS, *Fishes of Panama Bay*, Mem. California Acad. Sci., vol. 4, 1904, p. 157.—SNODGRASS and HELLER, *Shore Fishes of the Galapagos Islands*, Proc. Washington Acad. Sci., vol. 6, 1905, p. 412.

One specimen, field No. 09563, 21.5 cm. long, from Paita, and one, field No. 1007, 22.5 cm. long, from mouth of Tumbes River, Tumbes, taken with a casting net, "ataraya."

Head 2.9 in length; depth 3.8; eye 5.63-6.8 in head; interorbital 2.15-2.3; snout 2.1-2.2; D. 8; A. 7; interorbital space broad, nearly flat; outline of snout straight or concave; head broad and short; body short and robust.

In an individual from Tumbes, in which the belly was inflated at time of death, the prickles are very distinct; these are sharp and close-set on back from front of eye backward nearly to dorsal; those on ventral surface from front of eye to vent, anteriorly extending up on side of head to level of middle of base of pectoral; rest of head, sides of body to vent and all of body behind vent without prickles.

Color in spirits of Paita example, back very dark, thickly dotted with small black spots, varying in size in different parts of the body, but those on sides larger, but always smaller than pupil; well-marked light-colored concentric rings, characteristic of the species, cross back, becoming quite indistinct on sides; the central one ovate in shape, about three-fourths inch in diameter about midway between anterior border of eye and base of caudal; three others cross back between this and the posterior border of eye; a number of irregular lines across snout; belly white; line of demarkation between color of sides and belly; fins whitish gray. In the individual from Tumbes there are fewer spots on the sides and back; and the concentric lines are indistinct.

Pacific coast of tropical America and the Galapagos Islands; generally common in sandy bays from Cerros Island to Peru; once recorded from San Diego.

### Family GOBIIDAE.

#### THE GOBIES.

##### KEY TO GENERA.

- $\alpha^1$ . Ventral fins separate; body scaly; vomer with a broad patch of villiform teeth; skull above with conspicuous elevated ridges, one of these bounding the orbit above, the orbital ridges connected posteriorly by a strong cross ridge.....*Philypnus*, p. 133.
- $\alpha^2$ . Ventral fins united.
  - $b^1$ . Dorsal fins separate, free from caudal; upper rays of pectoral silklike; tongue emarginate.....*Mapo*, p. 134.
  - $b^2$ . Dorsal fin continuous, the soft part and the anal joined to the base of the caudal; body elongate, entirely scaled; teeth in a band; those of the outer series very strong.....*Gobioides*, p. 134.

### Genus PHILYPNUS Cuvier and Valenciennes.

#### THE GUAVINAS.

##### 153. PHILYPNUS MACULATUS (Günther).

*Lembus maculatus* GÜNTHER, Cat. Fish. Brit. Mus., vol. 1, 1859; Andes of Ecuador.

*Philypnus lateralis* GILL, Proc. Acad. Nat. Sci. Phila., 1860, p. 123; Cape San Lucas—JORDAN and EVERMANN, Fishes of North and Mid. America, vol. 3, 1898, p. 2195.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 167.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 799; Guayaquil, Ecuador, and Eten, Peru.

*Philypnus maculatus* REGAN, Biologia Centrali-Americana, Pisces, p. 5, 1906, pl. 1, fig. 2.

40856°—Bull. 95—17—10

Genus *MAPO* Smitt.159. *MAPO SOPORATOR* (Cuvier and Valenciennes).*PEJE-GAPO*.

*Gobius soporator* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 12, 1837, p. 42 (56); Martinique.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 3, 1898, p. 2216.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 171.

*Mapo soporator* SNODGRASS and HELLER, Shore Fishes of the Galapagos Islands, Proc. Washington Acad. Sci., vol. 6, 1905, p. 416.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 799.

Two specimens, field No. 277 (part), 10.5 and 12.4 cm. long, and two, field No. 278 (part), 6.6 and 8.3 cm. long, from Lobos de Afuera. The latter were taken from a shallow tide pool.

Head 3.3 in length; depth 5; eye 4.5 in head; snout 3.1; maxillary 2.2; interorbital 2 in eye; D. VI-I, 9; A. I, 9; 13 scales in transverse row, 33 transverse rows of scales from opercle to base of caudal.

Body robust, slightly depressed anteriorly, compressed posteriorly; head low, depressed, evenly rounded; cheeks tumid; eyes large, on upper surface of head, interorbital concave; lips thick and fleshy; mouth large, nearly horizontal; maxillary reaching a little behind vertical from anterior border of eye; teeth in jaw in broad bands, the outer row in each enlarged, tongue notched at tip; head naked. The breadth of the head varies considerably; in some of the larger specimens in which the cheeks are very tumid the breadth equals the length, in others it is considerably less.

Spinous dorsal low, the spines very weak; dorsal rays directed backward, the posterior rays long, reaching base of caudal, 1.75 in head; caudal rounded; anal similar in shape to soft dorsal, but shorter; ventrals united into a disk, reaching vent, 1.5 in head; pectoral rounded, the upper rays silk-like, longest rays 1.25 in head, ventrals united into a disk, reaching vent, 1.5 in head.

Color in spirits: A very dark olive brown, indistinctly barred with darker; cheeks and jaws with darker markings. Description based on a specimen 12.4 cm. long.

Genus *GOBIOIDES* Lacépède.

## THE BARRITOS.

160. *GOBIOIDES PERUANUS* (Steindachner).

*Amblyopus broussonetii* GÜNTHER, Cat. Fish. Brit. Mus., vol. 3, 1861, p. 186; coast of Peru; not of Lacépède.

*Amblyopus (Gobioides) peruanus* STEINDACHNER, Fisch-Fauna Causa und Flüsse bei Guayaquil, Denkschr. Akad. Wiss. Wien, vol. 42, 1880, p. 42 (94), pl. 2, fig. 2, 2a; Guayaquil.

*Gobioides peruanus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 3, 1898, p. 2264.

*Gobioides peruanus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 861.

One small specimen, field No. 09542, 8.5 cm. long, taken with a boat beam-trawl, Bay of Paita, southwest of Caleta Colan, in 7 fathoms of water, soft mud bottom; no other fishes taken here.

Head 6.29 in total length; depth 10.6; eye very small, about 13.5 in head; snout 3.85; maxillary 2.25; interorbital 3.37; caudal 4.25 in total length, confluent with dorsal and anal; D. VII, 16; A. I, 15.

Color in alcohol: Flesh colored, dusky points on back and sides with indistinct traces of about 20 darker crossbars; fins blackish; base of dorsal white.

As this small individual presents some slight differences from the current descriptions of the adult, we quote the description of this species as given by Jordan and Evermann:

"Head 5; depth 11; D. VII, 17; A. I, 16. Eye scarcely visible, much smaller than in *G. broussonetii*; scales very minute; snout 2.5 in postorbital part of head; interorbital 5 in head; lower jaw slightly projecting; maxillary 2.6 in head; a series of large slender teeth in each jaw, behind which, in each jaw, is a narrow band of fine teeth; caudal 4.33 in body, connected by membrane to dorsal and anal; sides with regular cross series of pores. Body with narrow angular crossbars; dorsal rays violet, the membrane yellowish. Shores of Ecuador and Peru, ascending rivers."

### Family ECHENEIDIDAE.

#### THE REMORAS.

#### Genus ECHENEIS (Artedi) Linnaeus.

##### 161. ECHENEIS REMORA Linnaeus.

*Echeneis remora* LINNAEUS, Syst. Nat., ed. 10, 1758, p. 260, in "Pelago Indico."—PHILIPPI, Peces Nuevos de Chile, Ann. Univ. Chile, vol. 93, 1896, p. 376.—JORDAN and EVERMANN, Fishes Hawaiian Islands, Bull. U. S. Fish Comm., vol. 23, pt. 1, 1903 (1905), p. 494.

*Remora remora* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 3, 1898, p. 2271.—ABBOTT, Marine Fishes Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 863.—GILBERT and STARKS, Fishes Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 180.—SNODGRASS and HELLER, Shore Fishes Galapagos Islands, Proc. Washington Acad. Sci., 1905, p. 421.

## Family SCORPAENIDAE.

## THE ROCKFISHES.

## KEY TO GENERA.

- $\alpha^1$ . Dorsal XIII, 14.-----*Sebastichthys*, p. 136.  
 $\alpha^2$ . Dorsal XII or XIII, 10.  
 $\beta^1$ . Pectoral with some of its median rays more or less branched.  
*Scorpaena*, p. 137.  
 $\beta^2$ . Pectoral rays all simple; head more or less scaly, the scales ctenoid.  
*Pontinus*, p. 138.

## Genus SEBASTICHTHYS Gill.

## KEY TO SPECIES.

- $\alpha^1$ . D. XIII, 14; A. III, 7; gillrakers 9+21, longest 2.37 in eye ---*chamaco*, p. 136.  
 $\alpha^2$ . D. XIII, 13; A. III, 6; gillrakers 10+18, longest nearly as long as pupil.  
*darwini*, p. 137.

## 162. SEBASTICHTHYS CHAMACO, new species.

## CHAMACO.

## Plate 12, fig. 3.

Six specimens, field Nos. 504, 545-549, 18.5-24.8 cm. long, from Mollendo.

*Type*.—Cat. No. 77621, U.S.N.M. (field No. 548), a specimen 35 cm. long, from Mollendo.

Head 2.4 in length; depth 2.83; eye 4.52 in head; snout 3.9; inter-orbital 6.61; maxillary 2.02; fourth dorsal spine highest, 3.24; second anal spine longest and strongest, 2.77; height of anal rays 2.45; pectoral 1.36; 10 lower pectoral rays simple, thickened; D. XIII, 14; A. III, 7; scales about 48, 38 pores; accessory scales numerous on back to level of base of pectoral, below that not nearly so numerous; gillrakers 9+21; comparatively short and stout, longest 2.37 in eye; lower jaw projecting; preopercle with five stout spines, notches very distinct; nasal, preocular, supraocular, postocular, tympanic and parietal spines strong; opercular, suprascapular and scapular spines smaller.

Dorsal spines low, shorter and more slender than the second anal spine; caudal rounded; ventrals reaching just behind anus, pectoral longer, reaching to middle of space between anus and origin of anal.

Color in alcohol, back reddish brown, becoming silvery gray below; maxillary with a dark reddish brown stripe in center; another, wider, parallel with preopercle, just above maxillary; indistinct traces of two more behind eyes; five dark reddish brown saddles on back scarcely reaching lateral line; the first at origin of dorsal; second under fifth to sixth dorsal spines; third under ninth to

twelfth dorsal spines; fourth under third to tenth soft rays; fifth crossing caudal peduncle; some of the scales on dark area silver gray; membrane between seventh and eighth dorsal rays reddish brown; fine grayish; a brownish area on base of pectoral.

Paratypes have head 2.23-2.4 in length; depth 2.5-3; eye 4.05-4.52 in head; snout 4-4.3; interorbital 6-6.81; maxillary 2.02-2.13; highest dorsal spine 3.24-3.37; second anal spine 2.2-2.77; simple pectoral rays 9 or 10; D. XIII, 14; A. III, 7.

The dark reddish brown saddles on the back are wider than the silvery gray interspaces; midway between base of dorsal and lateral line the second and third saddles are connected by scales of same color; below this the scales are light silvery gray, giving the appearance of a light spot similar to the one in *S. oculata*, which, however, has it between the first and second light spots on the back.

This species has the spines of head weaker than *S. oculata*; the dorsal spines stronger, and the body shorter and thicker.

#### 163. SEBASTICHTHYS DARWINI (Cramer).

? *Sebastes oculata* JENYNS, Zool. Voy. *Beagle*, Fishes, 1848, p. 37; Valparaíso.

*Sebastes darwini* CRAMER, Proc. California Acad. Sci., 1896, p. 240; Mexilones, Peru.

*Sebastodes darwini* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1832.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 360.—DELFIN, Cat. Peces de Chile, 1901, p. 79.

### Genus SCORPAENA (Artedi) Linnaeus.

#### THE SCORPION FISHES.

#### 164. SCORPAENA HISTRIO Jenyns.

##### PARLAMO; FEJE-DIABLO.

*Scorpaena histrio* JENYNS, Zool. Voy. *Beagle*, Fishes, 1842, p. 35, pl. 8; Chatham Island, Galapagos Archipelago.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 2, 1860, p. 115.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 1843.—STEINDACHNER, Fauna Chilensis, 1898, p. 283.—DELFIN, Cat. Peces de Chile, 1901, p. 79.

One example, field No. 09497, 19.8 cm. long, from Lobos de Afuera.

Head 2.3 in length; depth 3; eye 4.3 in head; snout 3.38; maxillary 2.06; D. XII, 10; A. III, 5; tubes of lateral line 26.

Head large, its width equaling its depth; interorbital space narrow, deeply concave; its depth about one-half width, which is 2.06 in eye; nasal spines small, sharp; preocular ridges very prominent, spines stout; supraocular spines short, stout, blunt; postocular spines moderate; a broad deep pit on occiput; preorbital broad, without prominent ridges, a shallow depression under eye; sub-

orbital ridge equidistant from eye and maxillary, grooved, ending in a small spine posteriorly; preopercular spines 4, moderate, the upper of which lies just below and posterior to suborbital spine, longest; opercle ending in two strong, flat, divergent spines; mouth very large, horizontal; maxillary reaching to below posterior border of eye; jaws equal; broad bands of teeth on jaws, vomer and palatines; pseudobranchiae large. Scales moderate, cycloid, those on breast very small; area under suborbital ridge and on opercle above preopercular spine scaly, rest of head naked. Dorsal spines moderate, the third longest, 2.9 in head, equal to longest dorsal ray; caudal moderate, rounded, 2 in head; anal spines stout, second longest, equal to longest dorsal spine; anal rays long, 2.33; ventrals moderate, reaching anus, a little over 2 in head; pectoral broad, of 20 rays, the first and 12 lower rays unbranched. the lower rays somewhat thickened, length 1.48 in head.

Color in alcohol, head dark reddish brown, darkest on opercle; ventral surface on head creamy, tinged in places with rosy; back and sides brownish red, becoming creamy white on belly; sides with traces of four wide indistinct cross-bars; ventrals color of belly, dusky at tips, other fins mottled; two dark mottled cross bands on caudal and three on pectoral.

This species is closely related to *Scorpaena pannosa* Cramer, from Panama.

Panama to Juan Fernandez and Galapagos Archipelago.

#### Genus PONTINUS Poey.

##### 145. PONTINUS DUBIUS Steindachner.

##### PUNAL.

*Pontinus dubius* STEINDACHNER, Herpet.-Ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien., vol. 72, 1902, p. 38, pl. 8, fig. 1; Paita, Peru.

One example, No. 09549, 16.1 cm. long, from Paita, the type locality of the species.

As stated by Steindachner, this species is very close to *P. furcistrhinus* Garman and needs comparison with the type of that species. The individuals from Paita are slenderer, have the greatest depth of body at origin of dorsal, and present certain minor differences which may not be apparent when compared with a larger number of individuals.

Head 2.26 in length; depth 3.23; eye equaling snout, which is 3.63 in head; maxillary 2, reaching to below posterior border of orbit; interorbital narrow, deeply concave, its width 2.35 in orbit; pectoral base nearly equal to orbit in breadth, its length 1.89 in head; pectoral rays 18, simple, projecting beyond membrane; ven-

trials extending to posterior border of vent, 1.76 in head; first dorsal spine 1.55 in second, second 1.75 in third which is the longest, 1.71 in head; eleventh dorsal spine short, 1.23 in twelfth which is 3.75 in head; soft dorsal 2.4; second anal spine strong, longer than third, 2 in head; D. XII, 10; A. III, 6; scales ctenoid, easily detached (nearly all gone in specimen), 26 pores in lateral line; scales on cheeks, opercles, suborbital and nape, these replaced anteriorly on snout, interorbital and preorbital by small rudimentary scales or prickles; bands of villiform teeth on jaws, vomer and palatines; premaxillaries widely separated; symphyseal knob of upper jaw very prominent.

Head comparatively smooth; spines compressed, knife-like; nasal spines small; preocular, supraocular, postocular, tympanic, and occipital spines moderate; paroccipital ridge containing a single small spine immediately behind eye and another somewhat larger one at its posterior extremity; suborbital ridge strong, with four sharp spines; margin of preorbital with two strong diverging spines; upper spine of preopercle very strong, curved outward, slightly below suborbital ridge and with a small spine at its base; three other preopercular spines below this, the middle one the stronger; no pit on occiput or below front of eye; no transverse ridge at end of interorbital space; opercle with two diverging spines. Some of the spines on crown of head near filaments; nostrils small, the anterior the smaller, with a small tube and a long fringed dermal flap.

Color in alcohol, light yellow, possibly red in life; fins yellowish, tinged with pink; soft dorsal and caudal rays spotted with black; tips of caudal and ventrals blackish; a few blackish spots in center of pectoral; traces of blackish areas on base of spinous and soft dorsal, these probably continued onto body, the loss of the scales making it impossible to determine their extent.

*Pontinus strigatus* Heller and Snodgrass from Galapagos Islands is closely related to this species.

### Family AGRIOPODIDAE.

#### Genus AGRIOPUS<sup>1</sup> Cuvier and Valenciennes.

##### 166. AGRIOPUS PERUVIANUS Cuvier and Valenciennes.

*Agriopus peruvianus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 4, 1829, p. 286 (389); San Lorenzo Island near Lima.—GUICHENOT in Gay, Hist. Chile, Zool., vol. 2, 1848, p. 181, I, Atlas, Zool. Ictiol., pl. 2bis, fig. 1, 1854.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 2, 1860, p. 138.—STEINDACHNER, Fauna Chilensis, 1898, p. 297.—DELFIN, Cat. Peces de Chile, 1901, p. 80.

*Agriopus peruianus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 361.

<sup>1</sup> Because of the uncertainty regarding the author of the genus *Ongliopodus* (see Günther, Proc. Zool. Soc. London, 1871, p. 659), we have retained the generic name *Agriopus*.

## Family PLEURONECTIDAE.

## THE FLOUNDERS.

## Subfamily HIPPOGLOSSINAE.

## THE HALIBUTS.

## Genus PARALICHTHYS Girard.

## KEY TO SPECIES.

- $\alpha^1$ . Gillrakers 6 to 8+16 to 18; scales ctenoid.....*adpersus*, p. 140.  
 $\alpha^2$ . Gillrakers 4 or 5+11 to 13; scales cycloid.....*woolmani*, p. 140.

## 167. PARALICHTHYS ADSPERSUS (Steindachner).

## LENGUADO.

*Pseudorhombus adpersus* STEINDACHNER, Ichth. Notizen, vol. 5, 1867, p. 9, pl. 2; Chinchas Islands.

*Paralichthys adpersus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 2, 1898, p. 2627.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 363.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 800.

Two specimens, field No. 419, 24 and 27.3 cm. in length; two, field Nos. 09575-6, respectively 25 and 25.3 cm. in length, from Callao; and one, No. 501, 24.5 cm. in length, from Mollendo.

Head 3.18 to 3.21 in length; depth 2.18; snout to upper eye 3.65 in head; maxillary extending beyond vertical from posterior border of eye; 2.2 to 2.3; upper eye 6.5 to 7; interorbital 1.4 to 1.6 in eye; D. 67 to 72; A. 55 to 59; gillrakers 6 to 8+16 to 18; P. 12; V. 6; scales about 110; mouth large; teeth long and sharp, slightly incurved; jaws subequal; dorsal and anal of equal height, longest rays 2.8 to 2.85 in head; caudal double concave, middle rays longest, 1.45 to 1.5; breadth of caudal peduncle 2.8; ventrals small, 3.25 to 3.6; pectorals 2.05 to 2.12; scales ctenoid, very rough; snout and mandible without scales; a few scales on maxillary; rays of fins broadly scaled, membranes naked; lateral line strongly arched, the chord of the arch 2.25 to 2.5 in head, 3.5 to 4 in straight part of lateral line.

Color in alcohol, coloration variable, brown or brownish gray; fins mottled; body thickly covered with dark spots, rings and dots or quite plain.

## 168. PARALICHTHYS WOOLMANI Jordan and Williams.

## LENGUADO.

*Paralichthys woolmani* JORDAN and WILLIAMS, Proc. U. S. Nat. Mus., 1896, p. 457; Panama, erroneously credited to Galapagos Islands.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 3, 1898, p. 2628.—GILBERT and STARKS, Fishes of Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 197.

*Paralichthys sinaloae* JORDAN and ABBOTT in Jordan and Evermann, Fishes of North and Mid. Amer., vol. 3, 1898, p. 2872; Mazatlan and La Paz.

One specimen, field No. 09561, 42.4 cm. in length, from Paita.

Head, including opercular membrane, 3.16 in length to base of caudal; depth 2.15; snout to upper eye 4.54 in head; maxillary broad, extending slightly beyond vertical from posterior border of eye, 2.27 in head; upper eye 7.5 in head; interorbital rather broad, 1.4 in eye; D. 70; A. 57; gillrakers 4+13; scales about 100.

Caudal peduncle broad, 2.53 in head; dorsal high, longest dorsal ray equaling longest anal ray, 2.86; middle rays of caudal longest, 1.37; ventrals small, inserted under posterior preopercular margin, 3.4; pectoral longer than ventrals, 1.98; scales cycloid, small anteriorly, becoming larger posteriorly; arch of lateral line very high, chord of arch 1.9 in head, 3.5 in straight part of lateral line.

Color in alcohol, dark chocolate brown; fins mottled.

This species closely resembles *P. dispersus* from which it may be distinguished by the cycloid scales and the fewer gillrakers which are stronger, farther apart and armed with coarser teeth on their inner edge.

### Subfamily PSETTINAE.

#### THE TURBOTS.

#### Genus CITHARICHTHYS Bleeker.

#### 169. CITHARICHTHYS GILBERTI Jenkins and Evermann.

#### TAPADERO.

*Citharichthys gilberti* JENKINS and EVERMANN, Proc. U. S. Nat. Mus., 1888, p. 157; Guaymas, Mexico.—JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 3, 1898, p. 2686.—STEINDACHNER, Herpet.-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 45; Guayaquil.—GILBERT and STARKS, Fishes Panama Bay, Mem. California Acad. Sci., vol. 4, 1904, p. 200.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 80, 1906, p. 800; Guayaquil.

Two specimens, field No. 1004, 17 and 21.5 cm. long, from Tumbes, taken with a casting net at the mouth of the Tumbes River.

Head 3.78 in length; depth of body 2.17; D. 89; A. 68; scales 44(2).

Snout without spine 4.27 in head (measured from upper eye); eyes equal, 5.87 in head; interorbital space very narrow, 2.66 in eye, slightly grooved and scaled on posterior portion only; maxillary 2.54 in head, reaching to posterior border of pupil; jaws subequal, the upper slightly projecting; teeth small, in a single series; gillrakers slender, 6+14, the longest 2.28 in eye; dorsal beginning in advance of eye, highest ray 2.76 in head; pectorals unequal, the one on eyed side 1.78 and the other 2.47 in head; ventrals 3.13; highest anal ray

2.47; length of caudal 1.3; scales large, ciliated, those on anterior part of body and near margins of disk becoming smaller.

Color in alcohol, dark brown with traces of darker spots; the rays of the fins with darker markings; lower surface yellowish, scales with silvery centers, which tend to form longitudinal lines along the rows of scales.

D. 86; A. 67 in smaller individual.

This species occurs on the Pacific coast of tropical America and is abundant in sandy bays from Guaymas to Panama, ascending all the streams. (Jordan and Evermann.)

Starks states that an example from Guayaquil was very dark in color but otherwise not different from specimens from Panama. Steindachner gives the fin counts for two specimens from the same locality, D. 84; A. 63. This is a greater number than is recorded for northern individuals. Our specimens have more dorsal and anal rays, a little slenderer body, and a slightly shorter head and maxillary, otherwise they agree very well with the type.

### Genus ETROPUS Jordan and Gilbert.

#### 176. ETROPUS ECTENES Jordan.

*Etropus ectenes* JORDAN in JORDAN and GOSS, Rev. Flounders, Rep. U. S. Fish Comm., 1886 (1889), p. 277; Callao, Peru.—ABBOTT, Marine Fishes Peru. Proc. Acad. Nat. Sci. Phila., 1899, p. 364.

### Family BLENNIIDAE.

#### THE BLENNIES.

##### KEY TO GENERA.

- a<sup>1</sup>. Body scaly; teeth in jaws in more than one row; a band of villiform teeth behind outer enlarged row; teeth on the vomer and palate-----  
*Leptisoma*, p. 143.
- a<sup>2</sup>. Body scaleless.
  - b<sup>1</sup>. Teeth comb-shaped, in a single row in each jaw.
    - c<sup>1</sup>. Teeth all fixed, attached to the bones of the jaw and not movable.
      - d<sup>1</sup>. Gill membranes free from the isthmus or at least forming a distinct fold across it-----*Blennius*, p. 146.
      - d<sup>2</sup>. Gill membranes broadly united to the isthmus, the gill openings restricted to the sides-----*Hypoleurochilus*, p. 146.
    - c<sup>2</sup>. Teeth of front of jaws all movable, implanted on the skin of the lips.
      - e<sup>1</sup>. Posterior canines present in one or both jaws-----*Alticus*, p. 146.
      - e<sup>2</sup>. Jaws without posterior canines-----*Salarias*, p. 147.
  - b<sup>2</sup>. Teeth unequal, not comblike; a single series of strong, blunt conical teeth on jaws, vomer and palatines-----*Emblemaria*, p. 147.

## Genus LEPISOMA DeKay.

## KEY TO SPECIES.

♂. D. XVII-XIX, 11-13; A. II, 19-21.

♂. Color variable, typical examples with brown or black spots and dark cross-bands.

♂. Scales (pores) about 65; an outer row of enlarged conical canines intermingled with small teeth on vomer and palatines; normal fin counts D. XVIII, 12 or 13; A. II, 19.....*xanti*, p. 143.

♂. Scales (pores) 69 to 73; teeth on vomer and palatines in three patches, teeth of each patch of nearly uniform size; normal fin counts D. XIX, 13; A. II, 19 or 20.....*philippi*, p. 144.

♂. Color plain blackish brown or grayish brown.....*peruviana*, p. 145.

♂. D. XXV or XXVI, 11 or 12; A. II, 22 or 23.....*microcirrhis*, p. 146.

## 171. LEPISOMA XANTI (Gill).

## TRAMBOLLO.

*Labrosomus xanti* GILL, Proc. Acad. Nat. Sci. Phila., 1860, p. 107; Cerro Blanco.

*Labrisomus xanti* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 3, 1898, p. 2362.

One specimen, field No. 09498, 14.2 cm. in length, from Lobos de Afuera.

Head 3.15 in length; depth 3.74; eye 5.1 in head; snout 3.54; maxillary 2.15; interorbital 7.8; pectoral 1.26; D. XVII, 13; A. II, 19; scales (pores) 65.

Body compressed; head somewhat pointed, not so robust as in the types without scales; mouth large, the maxillary reaching vertical from center of eye; jaws with an outer row of enlarged canine-like teeth, those on sides becoming gradually smaller; behind these are bands of villiform teeth; teeth on vomer in a  $\Lambda$ -shaped area, main series with 4 enlarged canines, between and behind which are smaller teeth; a patch of teeth on each palatine bone as in the type except that the outer series consists of smaller teeth, more nearly equaling in size those behind them; nuchal filaments well developed.

Dorsal spines of nearly uniform height, shorter than the soft rays, membrane of last ray practically reaching base of caudal; caudal small, rounded, of about 14 rays; insertion of anal midway between tip of snout and base of caudal, posterior rays longest; ventrals narrow, 1.5 in head; pectoral broad.

Color in alcohol (much faded) brownish, without spots, showing none of the characteristic markings of the species in its present condition.

173. *LEPISOMA PHILIPPI* (Steindachner).

## TRAMBOLLO; CHALAPO.

Plate 13, fig. 1.

*Clinus philippi* STEINDACHNER, Ichth. Notizen, III, Sitz. Akad. Wiss. Wien, vol. 53, 1866, p. 210; West Coast of South America.

*Clinus fortidentatus* COPE, Proc. Amer. Philos. Soc., 1877, p. 42; Callao, Peru.

*Labrisomus philippi* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1890, p. 361.—DELFIN, Cat. Peces de Chile, 1901, p. 94.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 800; Callao.

Three specimens, field Nos. 09121, 09124, and 09126, respectively 26.5, 22, and 17 cm. in length, from Callao, Lima market, and fish hucksters; two, field Nos. 474 and 475 (=09719), respectively 24.5 and 29 cm. in length, from Ballestas Island, region of Pisco, taken with a trammel net (trasmalla) in 1-3 fathoms; one, field No. 09594, 22.2 cm. in length from Chinchá Island; and one, field No. 09638, 11.2 cm. in length, from Independencia Bay, Isle Vieja, Santa Rosa Island, east side. The common name for this species in this locality is "Chalapo," probably a corruption of "Chalaco"; one specimen, field No. 09668, 31.5 cm. in length from Chimbote, taken in a trap in water  $2\frac{1}{2}$  fathoms, near shore.

Head 2.85 to 3.15 in length; depth 3.05 to 3.6; eye 4.8 to 5.6 in head; snout 2.5 to 3.3; maxillary 2 to 2.75; interorbital 5.3 to 6.9; pectoral 1.25 to 1.45; D. XIX, 12 or 13; A. II, 19 or 20; scales (pores) 70-73.

Body compressed, tapering; head in the adult very robust, its breadth ranging from about 2.2 in head in specimen 11 cm. in length to 1.3 in specimens 30 cm. in length; snout, in the adult, blunt, maxillary reaching to vertical from posterior border of pupil; teeth essentially as in *L. xanti* except that those on the vomer and palate are in well-developed patches, and with the exception of the Chimbote specimen, the northernmost example in our collection, the teeth are of much more uniform size without unusually large teeth scattered among the smaller ones. In the example from Chimbote, the teeth approach closely the condition found in *L. xanti*. Interorbital rounded; nostrils small, the anterior with a multifid dermal flap, other similar dermal flaps over eye and on nape, the latter well developed; gillrakers short, 3+7; origin of dorsal over posterior margin of preopercle, spinous dorsal considerably lower than soft portion; caudal nearly truncate; membranes of anal deeply incised; ventrals moderate, about 2 in head.

Coloration in spirits of typical examples, brownish, tinged with yellow on belly; body crossed by six broad black crossbands, the dark bands continued across dorsal fins; several indistinct dark streaks radiating downward and backward from eye; head, body, and fins mottled with black or dark brown spots.

In other examples, the coloration is very dark and there are no traces of crossbands or spots; in others, the spots are distinct only on the head. In some of the specimens there is a very distinct black area on anterior part of spinous dorsal, similar to that found in the types of *L. xanti*.

Color in life of "Chalapo": Body very dark, covered with spots which are almost black, on dusky olivaceous background (Coker).

From a comparison of the type of *L. xanti* with examples of this species and an example of *L. jenkinsi* from the Galapagos Islands, it appears that the differences among the three species are very slight, if they do not actually intergrade. The typical color pattern for each is the same.

The fin-counts of examples of each are as follows: *L. xanti* (type) D. XVIII, 13; A. II, 19; of 12 specimens from San Lucas, one has D. XVII, 12; five have D. XVIII, 12, and five have D. XIX, 12; anal uniformly II, 19. One example from Lobos de Afuera in our collection, D. XVIII, 13; A. II, 19. *L. jenkinsi* (type and paratypes reported for three specimens) D. XIX, 11 or 12; A. II, 17 or 18; one specimen examined by us D. XIX, 11; A. II, 18.

*L. philippi*.—Of 8 specimens in our collection, seven have D. XIX, 13; A. II, 20; one has D. XIX, 12; A. II, 20. Of six specimens from Callao, Starks reports four with D. XIX, 13; A. II, 19; one with D. XIX, 12; A. II, 19 and one with D. XVIII, 13; A. II, 18.

*L. jenkinsi* has 55 to 61 pores in the lateral line, *L. xanti* has about 65, and *L. philippi* 69 to 73.

*L. jenkinsi* and *L. xanti* have an outer row of stout, canine-like teeth on vomer and palatines, intermingled with smaller teeth (in some cases only visible by a glass of quite high magnification). In *L. philippi*, with the exception of the northernmost representative, the vomerine teeth are in well defined patches and are usually of more nearly uniform size.

#### 173. *LEPISOMA PERUVIANA* (Cuvier and Valenciennes).

*Clinus peruvianus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 11, 1836, p. 283 (383); no locality given.

*Auchenionchus crinitus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 361; not of Jenyns.

The description of this species, based on a drawing by Feuillee, is too incomplete for certain identification. Because of its close resemblance to *L. variolosus* some authors have considered it identical

with *L. crinitus* of Jenyns, but if we accept the number of fin-rays as given in the original description, the description agrees equally well with *L. philippi*, the commonest species on the coast of Peru.

174. *LEPISOMA MICROCIRRHS* (Cavier and Valenciennes).

*Clinus microcirrhus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 11, 1836, p. 284 (384); Valparaiso.—GAY, Hist. Chile, Zool., vol. 2, 1848, p. 275.—COPE, Proc. Amer. Philos. Soc., vol. 17, 1877, p. 42.—DELFIN, Cat. Peces de Chile, 1901, p. 95.

*Clinus microcirrus* PHILIPPI, Ann. Univ. Chile, vol. 93, 1896, p. 379.

*Labrisomus microcirrhis* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 362.

The presence of palatine teeth and the close similarity of the species to *L. variolosus* indicate that this species undoubtedly belongs to the genus *Lepisoma*. It is recorded from the coasts of Peru and Chile.

Genus *BLENNIUS* (Artedi) Linnaeus.

175. *BLENNIUS TETRANEMUS* Cope.

*Blennius tetranemus* COPE, Proc. Amer. Philos. Soc., vol. 17, 1877, p. 42 (26); Pacasmayo Bay.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 362.

Genus *HYPLEUROCHILUS* Gill

176. *HYPLEUROCHILUS PAYTENSIS* (Steindachner).

*Blennius (Hypileurochilus) paytensis* STEINDACHNER, Ichth. Beltr., V, Sitz. Akad. Wiss. Wien, vol. 74, 1876, p. 171; Paita, Peru.

*Hypileurochilus paytensis* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 362.—STARKS, Fishes from Ecuador and Peru, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 800.

Starks records two specimens from Paita, the type-locality; these had 20 anal rays (one fewer than described for the type) and 17 and 15 dorsal rays, respectively (the type had 17).

Genus *ALTICUS* (Commerson) Lacépède.

177. *ALTICUS GIGAS* (Steindachner).

BORACHO; TORO.

*Salarias gigas* STEINDACHNER, Ichth. Beltr., V, Sitz. Akad. Wiss. Wien, vol. 74, 1876, p. 172; Callao.—STEINDACHNER, Fauna Chilensis, 1898, p. 809, pl. 19, fig. 7, 7a.—DELFIN, Cat. Peces de Chile, 1901, p. 92.

*Scartichthys gigas* ABBOTT, Proc. Acad. Nat. Sci. Phila., 1899, p. 361.

One specimen, field No. 09602, 24 cm. long, from Chincha Island; very common among the rocks along the shore; one, field No. 474 (part), 24 cm. long, from Ballestas Island, region of Pisco, taken with a trammel net, fishing in 1-3 fathoms; one, field No. 09638 (part), 10.4 cm. long, from Isla Vieja, Independencia Bay, east side Santa Rosa Island; one, field No. 09484, 18 cm. long; one, field No.

277 (part), 8.4 cm. long, and two, field No. 278 (part), 5.7 and 6.6 cm. long, from Lobos de Afuera; and one, field No. 120, 3 cm. long, from Chimbote, taken in a trap at the north end of Ferrol Bay, near shore.

Head 3.63 (4.44 in total) in length; depth 3.25 (4); eye 6 in head; snout 2.45; interorbital 4.5; ocular tentacle longer than eye, 3.6; maxillary 2.57; pectoral nearly as long as head; D. XI, 1, 18; A. 20.

Body robust anteriorly, compressed posteriorly, caudal peduncle 2.7 in head; head short, cheeks tumid; snout short, very steep; interorbital flat; a slight depression behind eye; lips fleshy, upper lip fringed; mouth horizontal, maxillary extending to below anterior border of eye; teeth fine, villiform, movable, forming an edge; lower jaw with strong canines.

Spinous dorsal originating above posterior border of opercle; dorsals high, separated by a notch, longest dorsal spine 2.34 in head, longest ray 1.8; caudal rounded; membranes between rays of anal deeply incised; lateral line strongly arched anteriorly, becoming straight under third dorsal ray.

Color in life, rich, deep dark red with green reticulations; the green quite evident below but barely distinguishable above. Just posterior to tips of most of the spines of the dorsal and anterior rays of soft dorsal are narrow red spots, long in a vertical direction.

This species differs from the "Trambollo" (*Lepisoma xanti*) in being lighter, with more green, and the spots are reddish. This description is based on a specimen 24 cm. long from Chincha Island.

In the other specimens the rays of dorsal are 17 or 18. The posterior canines, characteristic of the genus *Alticus*, are present in all.

#### Genus SALARIAS Cuvier.

##### 178. SALARIAS RUBROPUNCTATUS Cuvier and Valenciennes.

*Salarias rubropunctatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss., vol. 11, 1836, p. 348; Juan Fernandez.—GAY, Hist. Chile, Zool., vol. 2, 1848, p. 271.—STEINDACHNER, Fauna Chilensis, 1898, p. 309.

*Scartichthys rubropunctatus* JORDAN and EVERMANN, Fishes North and Mid. Amer., vol. 3, 1898, p. 2396; Callao.—ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 362.

Coast of Peru and Chile, north to Panama.

#### Genus EMBLEMARIA Jordan and Gilbert.

##### 179. EMBLEMARIA HUDSONI, new species.

##### TRAMBOLLO.

Plate 13, fig. 2.

Nine specimens, field No. 09537, 3.7 to 7.7 cm. long, from Sechura Bay, between Bayova and Mataballa, taken in dredge with shellfish at 5-6 fathoms.

*Type*.—Cat. No. 77535, U.S.N.M., 7.7 cm. long, has head 3.9 in length; depth 5.66; eye 4.5 in head; snout 4.5; maxillary 2.12; ocular cirrus 2.42; D. XXII, 16; A. 27: pectoral, 1.41; ventrals long, equal to head.

Body compressed; snout evenly decurved; mouth large, horizontal; maxillary extending about three-fourths diameter of eye behind posterior border of orbit; teeth in each jaw in a single row, stout, conical; those on palatines in a single row, conical, stronger than those on jaws; several smaller teeth on vomer, separated from those on palatine bones by a short interspace.

First dorsal inserted slightly behind vertical from posterior border of maxillary, spines long and very flexible, filiform, their tips not reaching beyond the membranes, fourth spine longest, equal to length of head; soft dorsal and anal confluent with the caudal; caudal rounded; 13 rays in pectoral; membrane in front of first dorsal spine, notched.

Color in alcohol, dusky brown with purplish reflections, traces of 7 darker cross-bars, bordered with narrow yellowish white lines, these lines scarcely discernible in the type, very distinct in some of the smaller specimens; spinous dorsal with dusky shades anteriorly and other dark shades at base of membranes of alternate spines, posteriorly; soft dorsal and caudal rays yellowish, membranes translucent; anal dusky, anterior half margined with black; ventrals dark; pectorals similar to caudal; ocular cirrus yellowish.

The paratypes have D. XXII-XXIII, 15-16. In some the ocular cirrus is half as long as head. Some of these have the underside of the head crossed by 4 dark cross-bands, a dark purplish area behind eye on cheek and another on opercle near nape; the yellow cross-lines on body very distinct. In the smallest individual the crossbands are broken into two longitudinal rows of dark areas, the upper row along base of dorsal of the shape of a figure 8, the lower row V-shaped.

An examination of the type of *E. nivipes* and of these specimens shows that the generic description as given by Jordan and Gilbert must be revised. The dorsal and anal are confluent with the caudal in both these species, and in neither are the teeth on vomer and palatines continuous. There is a single row of stout conical teeth on the palatines, then an interspace, and 2 or 3 smaller teeth on the vomer.

We take pleasure in naming this new species for our friend, Capt. Charles Bradford Hudson, artist and author, who has succeeded better than any other in depicting on canvas the life colors of American fishes.

## Family OPHIDIIDAE.

## THE OUSK EELS.

## Genus GENYPTERUS Philippi.

## KEY TO SPECIES.

- ♂<sup>1</sup>. Head 4.25 to 4.5 in total length. Back and sides dark chocolate brown, with a few light spots irregular in form and disposition; belly light of color, washed with salmon.....*blacodes*, p. 149.
- ♂<sup>2</sup>. Head 3.68 to 4 in total length. General color light chocolate brown, with very conspicuous hieroglyphic-like white markings over entire body and fins, these somewhat irregular in form and arrangement, but very characteristic in appearance.....*chilensis*, p. 150.

## 180. GENYPTERUS BLACODES (Bloch and Schneider).

## CONGRIO COLORADO.

*Ophidium blacodes* BLOCH and SCHNEIDER, Syst. Ichth., 1810, p. 484.—

CUVIER, Règne Anim., ed. 2, vol. 2, 1829, p. 359.

*Ophidium blancodes* TSCHUDI, Fauna Peruana, Ichth., 1845, p. 29.

*Ophidium maculatum* TSCHUDI, Fauna Peruana, Ichth., 1845, pl. 5.

*Genypterus blacodes* GÜNTHER, Cat. Fish. Brit. Mus., vol. 4, 1862, p. 379.—

DEFLIN, Cat. Peces de Chile, 1901, p. 99.—STEINDACHNER, Herpet-ichthyol., Ergebnisse einer Reise nach Südamerika, Denkschr. Akad. Wiss. Wien, vol. 72, 1902, p. 47.—DELFIN, Los Congrios de Chile, p. 189, pl. 13, fig. 2; Rev. Chilena Hist. Nat., No. 3, Año VII, June, 1903.

Two specimens, field Nos. 09707-8, respectively, 51 and 46.5 cm. in length, from Mollendo, taken with a trawl line in 46 fathoms not far from shore.

Head 4.25 to 4.5 in total length; depth 6.65 to 6.7; snout 4.25 to 4.6 in head; postorbital part of head 1.5; eye 7.25 to 8.5; interorbital 5.1 to 6.65; breadth of head 2.2; pectoral 2.06 to 2.12; breadth of pectoral base 4.6 to 4.8; maxillary 2.2 to 2.35.

Body elongate, tapering, compressed, greatest depth over base of pectoral; head elongate; snout blunt; lower jaw included; maxillary reaching beyond posterior border of eye by a distance nearly equal to its horizontal diameter; an enlarged outer row of stout, slightly incurved canine-like teeth in jaws, behind these narrow bands of smaller teeth, those in upper jaw in several rows in front, narrowing to a single row posteriorly, those in lower jaw mainly in one row; an outer row of enlarged teeth on vomer and palatines, similar to those on jaws; behind these an irregular row of smaller teeth; eyes small, anterior in position; nostrils small, separated by an interspace equal to one-half diameter of eye, the first provided with a small flap.

Distance from tip of snout to origin of dorsal 3.65 to 4 in total length; dorsal and anal low, confluent with the caudal; ventrals

filamentous, bifid, inserted at throat, under anterior half of eye; distance from tip of snout to vent 2.2 to 2.25 in total length.

Color in alcohol, back, sides, and fins slaty; ventral surface of head and belly anteriorly sulphur-yellow, becoming dusky posteriorly; sides with small irregular sulphur-yellow spots, very irregular in arrangement: pectorals with traces of spots, margined with sulphur-yellow.

Color in life, ventral aspect of head and abdomen light, unevenly washed with salmon; upper and lower lips deep salmon; the salmon-color of ventral surface extending backward along the base of anal fin; body dark chocolate brown, darkest above, with a few light spots, irregular in form and disposition; these spots smaller, more irregular in form and distribution and more sharply contrasted with the darker ground color, than those of the common congrio (*G. chilensis*). In the latter, the light markings, while somewhat irregular in form and arrangement, are yet very characteristic in appearance, being evenly distributed and tending to certain forms—circles, hour-glasses, etc. The circles may be complete or incomplete, entirely of a light color or with brown centers. Some of the con-grios, at least, show a bronze tint on the sides.

181. *GENYPTERUS CHILENSIS* (Guichenot).

CONGRIO; CHACHA.

*Conger chilensis* GUICHENOT In Gay, Hist. Chile, Zool., vol. 2, 1848, p. 339.

*Genypterus nigricans* PHILIPPI, Ann. Univ. Chile, vol. 19, 1857, p. 185; Wiegman Arch. Naturg., 1857, p. 629.

*Genypterus chilensis* GÜNTHER, Cat. Fish. Brit. Mus., vol. 4, 1862, p. 380.—ABBOTT, Proc. Acad. Nat. Sci. Phila., 1899, p. 475.—DELFIN, Cat. Peces de Chile, 1901, p. 99; Los Congrios de Chile, p. 189, pl. 13, fig. 1; Rev. Chilena Hist. Nat., No. 3, Año VII, June, 1903.

One specimen, field No. 09722, 65.5 cm. long, from Guanape North Island; one, field No. 09717, 48 cm. long, from Pisco; and three, field Nos. 09703, 08713, and 522, respectively 39.5, 36.5, and 36.5 cm. long, from Mollendo.

Head 3.68 to 4 in total length; depth 5.45 to 7.44; snout 4.14 to 4.95 in head; postorbital part of head 1.42 to 1.5; eye 7.46 to 9.36; breadth of head 1.76 to 2.67; interorbital 5.23 to 5.5; maxillary 2.33 to 2.6; length of pectoral 1.88 to 2.09; breadth of base of pectoral 5.05 to 5.25; distance from tip of snout to origin of dorsal 3.3 to 3.65; distance from tip of snout to anal 2.11 to 2.29; ventrals much shorter than head, not split to base. In form this species agrees with *G. blacodes*.

Color in life, general color light chocolate-brown, with very conspicuous hieroglyphic-like white markings over entire body; while these are somewhat irregular in form and arrangement, they are still very characteristic in appearance, are evenly distributed, and

tend to certain forms, as circles, oblongs, horseshoes, hourglasses, etc. These may be entirely of a light color or with brown centers.

This form is readily distinguished from the preceding by the coloration. In *G. blacodes*, the spots on the sides are much smaller and the under surface of the head and belly is abruptly sulphur-yellow, while in *G. chilensis* the ground color of the ventral surface resembles that of the sides and back, except that it is lighter and the hieroglyphic markings are continued on to the fins.

Aside from the striking differences in coloration, this species differs little from *G. blacodes*. A comparison of the measurements of our specimens and those given by Delfin seems to indicate that the head is a little longer, the average length of the maxillary and diameter of the eye less and the width of the interorbital greater in this species than in *G. blacodes*.

### Family BROTLIDAE.

#### Genus BROTLA Cuvier.

#### 182. BROTLA MACULATA, new species.

#### CONGRIO.

Plate 13, fig. 3.

*Type*.—Cat. No. 77702, U. S. Nat. Mus. (field No. 09551), 44 cm. long, from Paíta.

Head 4.08 in total length; depth 6.1; eye 6 in head; snout 4.8; maxillary 2.25; pectoral 2.16; ventrals 2.4; D. 105; A. 91; P. 25; scales about 26–220–68; interorbital narrower than eye, 6.35 in head; origin of dorsal slightly behind base of pectoral, its distance from tip of snout 3.92 in total length; vent cephalad of middle of body, its distance from tip of snout 2.25 in total length.

Body elongate, compressed, not so deep as in related species; mouth large, oblique, jaws nearly equal, the lower slightly projecting; maxillary long, reaching a distance of more than one-half orbit behind eye, its upper edge slipping under broad orbital bones, its expanded posterior extremity equal to interorbital width, 6.35 in head; anterior nostril without flap, posterior nostril with a slender barbel about two-thirds length of orbit; two barbels on each side of fleshy upper lip anteriorly; six barbels on under surface of head; all the barbels slender and rather short, the longest barely greater than diameter of eye; jaws, vomer, and palatines with narrow bands of minute teeth; tongue very thick, free, and pointed anteriorly; gill-opening large; isthmus narrow, grooved; gillrakers short, rather stout; pseudo-branchiæ well developed; opercle with a sharp stout spine above; body, head, and fins covered with embedded, minute, cycloid scales;

maxillary scaly; premaxillaries, mandible and branchiostegal membranes without scales; scales on fins smaller than those on body; dorsal and anal confluent with the caudal, a slight notch in tip of caudal; dorsal and anal low, about equal in height to diameter of eye; ventrals composed of a single bifid ray reaching to below posterior edge of head.

Color in alcohol, dusky olive with a brownish tint on back; several rows of very obscure round brownish spots on body, most distinct on tail, almost imperceptible when the fish is dry; fins body color; dorsal narrowly margined with gray; anal rather broadly margined with purplish black shading into body color.

This species is quite distinct from *B. barbata*, the Atlantic form. It is slenderer than that species or either of the Hawaiian species, and is the only species of the genus recorded from the Pacific coast of America.

Genus *PORICHTHYS* Girard.

183. *PORICHTHYS AFUERA*, new species.

Plate 14, fig. 1.

One specimen, field No. 09489*b*, 12.6 cm. in length, from Lobos de Afuera.

*Type*.—Cat. No. 77552, U. S. Nat. Mus.

Head 3 (3.6 total) in length; depth 5.1 (6.1); eye 5.83 in head; snout 4; maxillary 2.05; interorbital 3.3; pectoral 1.1; ventral 2.84; D. II, 33; A. 31; V. I, 2.

Body slender, compressed, tapering; head long, depressed, its breadth 1.58 in length; interorbital broad, flat; lower jaw projecting; snout rounded; teeth in lower jaw in a single row, unequal, canine-like, recurved, those in upper jaw smaller, equal in size; teeth on palatines in a single long row; two strong recurved teeth on the sides of the vomer, in the same straight line with the palatine row and separated from them by a slight interspace, the second of these much longer than the first; eye small, about 2 in interorbital width; opercular spine long and slender, only the tip projecting through the integument. In this species the lines of phosphorescent organs are essentially the same as in *P. margaritatus*, but much smaller and less clearly defined, in some places being almost invisible.

Dorsal and anal uniform in height, not confluent with the caudal; caudal rounded; ventrals short, anterior in their insertion, tips barely reaching base of pectorals; pectorals long, as long as that part of head anterior to tip of opercular spine.

Color in alcohol, sides and belly silvery white; back dusky gray, crossed by four broad brownish black saddles, these considerably wider than the interspaces, extending to middle of sides; alternating with the saddles are small spots of the same color; four oblique

brownish black areas on dorsal, corresponding to those on body, these confined to the distal half of the fin; alternating with the first and second, and, with the third and fourth are small black areas on margin of fin; posterior half of caudal black; two indistinct black marginal areas on anal posteriorly, with traces of about four others anteriorly; pectoral brownish at base, bordered by a V-shaped area of white, then a parallel brown area, margin of fin lighter; fins, where they are not marked with brownish black areas, white; top and sides of head brownish black, ventral surface white. This species closely resembles *P. porosus* of the Chilian fauna, but may be readily separated by the much longer head, the length of head in *P. porosus* being, according to Günther, 4.66 in the total length, while in this species it is only 3.41.

We know of no record of *P. porosus* from the coast of Peru and therefore have not included it in this list.

### Family GOBIESOCIDAE.

#### THE CLINGFISHES.

##### KEY TO GENERA.

- $\alpha^1$ . Incisors of lower jaw with entire edges; opercular spine strong; vertebrae about 28-----*Gobiesox*, p. 153.  
 $\alpha^2$ . Incisors of lower jaw tricuspid or serrate (at least in those on sides of jaw); opercular spine weak; vertebrae about 28-----*Arbacia*, p. 155.

#### Genus GOBIESOX Lacépède.

##### 184. GOBIESOX SANGUINEUS (Müller and Troschel).

*Sicyases sanguineus* MÜLLER and TROSCHER, Wiegmann, Arch Naturg., 1843, p. 298.—GÜNTHER, Cat. Fish. Brit. Mus., vol. 3, 1861, p. 494.—STEINDACHNER, Fauna Chilensis, vol. 2, 1898, p. 315.

*Gobiesox brevirostris* GAY, Hist. Chile, Zool., vol. 2, 1848, p. 335, pl. 9, fig. 1.

*Gobiesox sanguineus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 363.

Six specimens, 7.3–11.5 cm. long (no locality).

Head 2.37 in length; breadth of head 2.81; depth of body 6; eye 5.42 in head; snout 3.16; maxillary 3.8; interorbital 2.53; pectoral as wide as long, 3.16; D. 8; A. 6; C. 8; P. 23; V. 4 (5).

Head and body anteriorly broad and much depressed, compressed posteriorly; caudal peduncle slender, its depth 4.75 in head; head nearly as broad as long, sides converging toward the blunt snout; upper surface of head and interorbital space flat; mouth small, inferior, horizontal; lips fleshy, the lower 3-lobed, somewhat after fashion of *Exoglossum*; maxillary scarcely reaching vertical from anterior border of eye; teeth in each jaw in a single row, those in

front 6 in number; incisors with truncate cutting edge; behind these in each jaw two small canine-like teeth; nostrils small, on level with upper margin of orbit; anterior with a flap, prolonged on posterior side into a fringed tentacle; subopercle projecting backward, ending in a spine, covered with skin; head and body scaleless, covered with a leathery skin; distance from tip of snout to origin of dorsal 1.45 in standard length; longest dorsal ray 3.8 in head; caudal truncate, membranes between rays deeply incised; origin of anal under seventh dorsal ray, the distance from tip of snout to origin of anal 1.27 in standard length; vent anterior in position, separated from anal fin by a distance equal to interorbital space; ventrals in front of pectorals and connected with them; pectorals broad, posterior border convex; disk large, subcircular, longer than broad, its length 1.08 in head and its breadth 1.31.

Color in spirits, coppery red to flesh-color, back crossed by six broad, dark reddish crossbands, the first on nape; second behind pectorals; third in front of dorsal; fourth on base of dorsal; fifth on middle of caudal peduncle and sixth in front of base of caudal; fins yellowish, punctulate with dusky. This description is based on a specimen 11.5 cm. long.

The fin formula of these specimens is somewhat variable; one has D. 8; A. 5; another D. 8; A. 6 and four have D. 9; A. 6.

The following excellent description of the structure of the disk by Günther applies to these specimens:

The whole disk is exceedingly large, subcircular, longer than broad, its length being one-third of the whole length of the fish. The central portion is formed merely by skin, which is separated from the pelvic or pubic bones by several layers of muscle. The peripheric portion is divided into an anterior and posterior part, by a deep notch behind the ventrals. The anterior peripheric portion is formed by the four ventral rays, the membrane between them, and a broad fringe which extends anteriorly from one ventral to the other; this fringe is a fold of skin, containing on each side the rudimentary ventral spine, but no cartilage. The posterior peripheric portion is suspended on each side on the caracoid, the upper bone of which is exceedingly broad, becoming a free, movable plate behind the pectoral. A broad cartilage is firmly attached to it. The lower bone of the coracoid is of a triangular form, and supports a very broad fold of the skin, extending from one side to the other, and containing a cartilage which runs through the whole of that fold. Five processes of the cartilage are continued into the soft striated margin in which the disk terminates posteriorly. The surface of the disk is coated with thick epidermis, like the sole of the foot of higher animals. The epidermis is divided into many polygonal plates; there are no such plates between the roots of the ventral fins. (Günther.)

This species is found on the coasts of Peru and Chile.

As we have no record for the coast of Peru of *Gobiosoma marmoratus* of Jenyns, included by Abbott in his fishes of Peru, we have omitted it from our list. It is an abundant species to the southward, around Punta Arenas, Tumbes (Chile), Iquique, and the island of Juan Fernandez, and very probably may be found along the southern coasts of Peru.

Genus ARBACIOSA Jordan and Evermann.

KEY TO SPECIES.

- ♂. D. 5; A. 4; head 5 in total length; depth 11.....*pyrrhocincla*, p. 155.  
 ♂. D. 6 or 7; A. 5 or 6; head about 3.8 in total length; depth 7 in same  
 .....*hieroglyphica*, p. 155.

185. ARBACIOSA PYRRHOCINCLA (Cope).

*Sicyases pyrrhocinclus* COPE, Proc. Amer. Philos. Soc., vol. 17, 1877, p. 43 [in author's separate, p. 27 (Bur. Fish. Lib. Cope, vol. 5)]; exact locality not preserved.

*Arbacia pyrrhocinclus* ABBOTT, Marine Fishes of Peru, Proc. Acad. Nat. Sci. Phila., 1899, p. 363.

186. ARBACIOSA HIEROGLYPHICA, new species.

FEJE-SAPO.

Plate 14, fig. 2.

*Type*.—Cat. No. 77561, U. S. N. M., a specimen 4.1 cm. long, and a paratype 3.1 cm. long, both from Lobos de Afuera, taken from a very small and shallow tide pool in the rocks, measuring about 7 by 6 feet and 1 to 10 inches deep. (Field No. 278.)

Ten specimens, field No. 09448, 2.5 to 3.8 cm. long, from Lobos de Afuera.

Head 3.14 in length; depth 5.66; eye 5.4 in head; snout 3; maxillary 2.7; interorbital 2.57; pectoral 2.16; length of disk 1.35; D. 7; A. 6.

Head and body anteriorly depressed, body posteriorly compressed; caudal peduncle slender, its depth 3 in length of head; head nearly as broad as long; mouth small, inferior; maxillary reaching to vertical from anterior margin of eye; interorbital flat; cheeks tumid; incisors in upper jaw eight, the two in the center of the jaw truncate, those on sides serrate or tricuspid; behind these, at a short distance, a strong canine; six incisors on lower jaw, the two in center truncate, others serrate or tricuspid; distance from tip of snout to origin of dorsal 1.31 in standard length; dorsal low, rounded; caudal rounded; origin of anal behind origin of dorsal; distance from tip of snout to origin of anal 1.33 in standard length.

Ground color yellowish, tinged with olive; back crossed by wavy dark lines and dusky black spots, these irregular in shape and arrangement but tending to form darker crossbands on back; on back above pectorals are 5 black spots in the form of a V, the apex pointing forward, end spots most distinct; indistinct lines extending downward and backward from eye; vertical fins blackish, margined with yellowish.

Paratype 3.8 cm. long, has head 3.14 in length; depth 6.6; eye 6 in head; snout 3; interorbital 3; pectoral 1.75; disk 1.31; tip of snout to origin of dorsal 1.36; tip of snout to origin of anal 1.34; D. 7; A. 5.

Ground color yellowish, lighter on ventral surface; irregular dark lines and small dots of black on back; two small black spots on back above pectoral, separated by a distance slightly greater than interorbital width; a narrow line of brown connecting the eyes; 3 similar diverging lines extending downward and backward from eye; one from eye to slightly in front of angle of mouth, trace of another above this near upper angle of eye.

In these specimens the dorsal has six or seven rays, the anal five or six, and the coloration is quite variable.

This species is distinct from *A. pyrrhocincla* of Cope, the only previously recorded species of this genus from Peru. It appears from the description close to *A. petersii* of Garman, from Panama Bay, wrongly credited by Abbott as coming from Peru.

### Family MERLUCCIIDAE.

#### THE HAKES.

#### Genus MERLUCCIUS Rafinesque.

#### 187. MERLUCCIUS GAYI (Guichenot).

#### PEJE-PALO.

*Merlus gayi* GUICHENOT in Gay, Hist. Chile, vol. 2, 1848, p. 328, I, Atlas Zool. Ictiol., pl. 8, fig. 2, 1854; coast of Chile.

*Epicopus gayi* GÜNTHER, Cat. Fish. Brit. Mus., vol. 2, 1860, p. 248.

*Gadus australis* HUTTON, Cat. Fish. New Zealand, p. 45, *Hector*, 1872, p. 115, fig. 72.

*Merluccius gayi* HUTTON, Trans. New Zealand Inst., vol. 5, 1872 (1873), p. 266.

*Merluccius gayi* GÜNTHER, Cat. Fish. Brit. Mus., vol. 4, 1862, p. 346.—STEINDACHNER, Fauna Chilensis, 1898, p. 325.—DELFIN, Cat. Peces de Chile, 1901, p. 100; Contribucion, Ictiol. Chilena, Rev. Chilena Hist. Nat., vol. 7, 1903, No. 5-6, p. 269, fig. 7.

Four specimens, field No. 471, 16 to 17.5 cm. in length, and five specimens, field No. 472, 16 to 17 cm. in length, from Callao; also one specimen, field No. 09539, 42.5 cm. in length, from Paita.

Head 3.08 in length; depth 6.52; eye 5.68 in head; snout 3.37; maxillary 2.15; interorbital 3.9; pectoral 1.37; ventrals 2.27; D. 11-38; A. 38.

Body elongate, slender, tapering evenly to base of caudal; head long, low; interorbital broad, flat; eye large, posterior border of eye midway between tip of snout and posterior border of opercle; mouth large; lower jaw longest; maxillary reaching vertical from middle of eye; teeth in jaws long, slender, curved, very sharp, mainly in two rows; similar teeth on vomer, none on palatines; opercular bones weak; opercle ending in a weak spine. First dorsal higher than the second; second, third, and fourth rays about equal, longer than others, 2.75 in head; second dorsal and anal each with a deep emargination in the center; caudal rounded; ventrals narrow, their tips reaching two-thirds distance from their base to origin of anal; pectoral long and narrow, tip extending to above sixth anal ray. Scales deciduous, small; lateral line decurved.

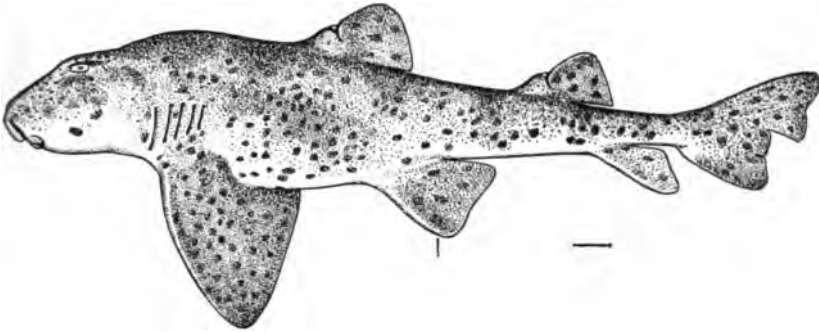
Color in alcohol, dusky on back, becoming lighter on belly; fins dusky; some of lower rays of pectoral, black. Description taken from field No. 09539, from Paita.

A smaller example from Callao has head 2.9 in length; depth 5.68 eye 5.55 in head; snout 3; interorbital 3.6; pectoral 1.35; ventrals 2.1; D. 11-37; A. 39. Color in alcohol, rosy, dusky on back, silvery on belly; opercle blackish; fins blackish; anterior anal rays and shortened rays in center of second dorsal and anal, whitish.

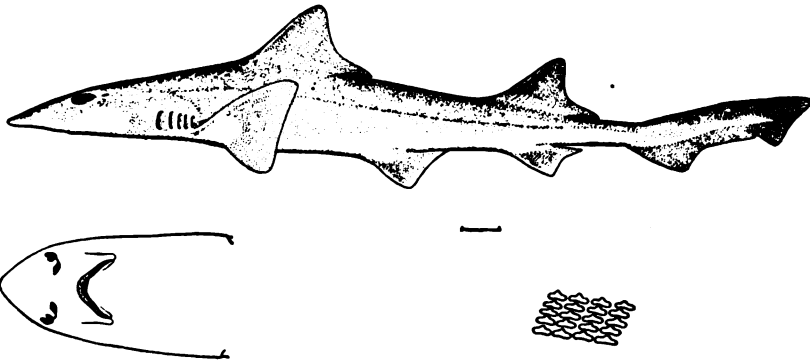
Guichenot's figure of this species does not show the shortened rays in the center of second dorsal and anal.

This species is very close to the northern Pacific form, *M. proeductus*, and occurs on the coasts of Peru and Chile.

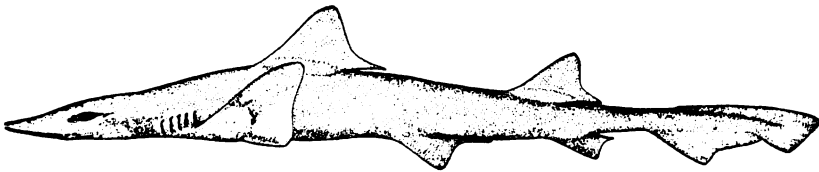




1. *GYROPLEURODUS PERUANUS*. FROM THE TYPE. (PAGE 2.)

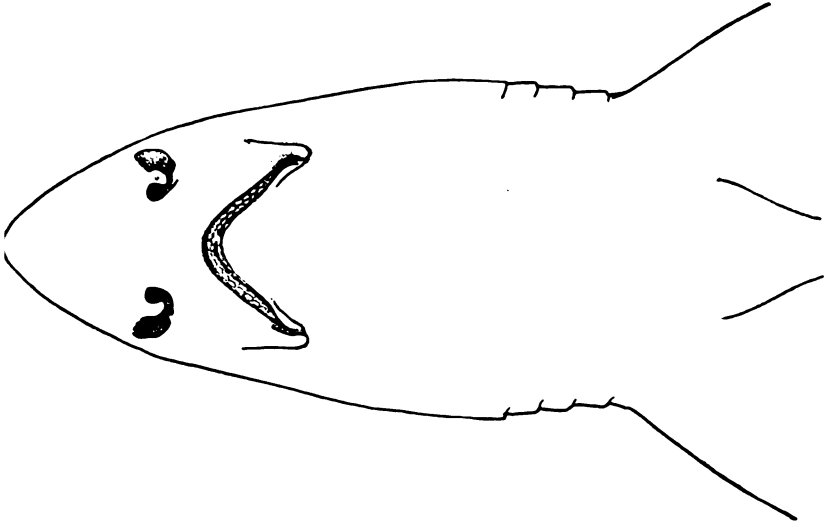


2. *MUSTELUS ABBOTTI*. FROM THE TYPE. (PAGE 6.)

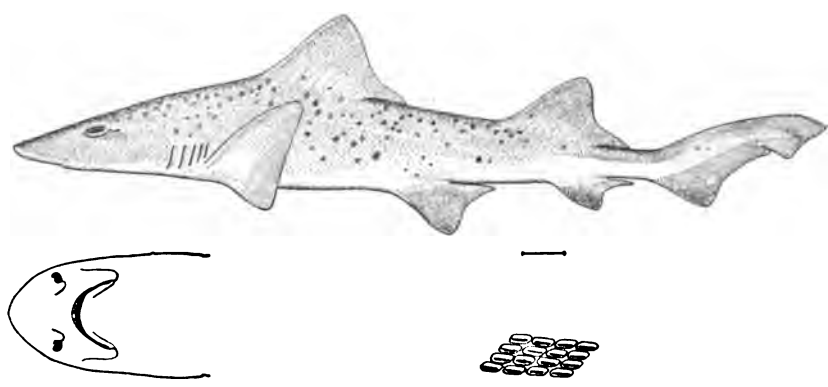


3. *MUSTELUS DORSALIS* GILL. (PAGE 7.)

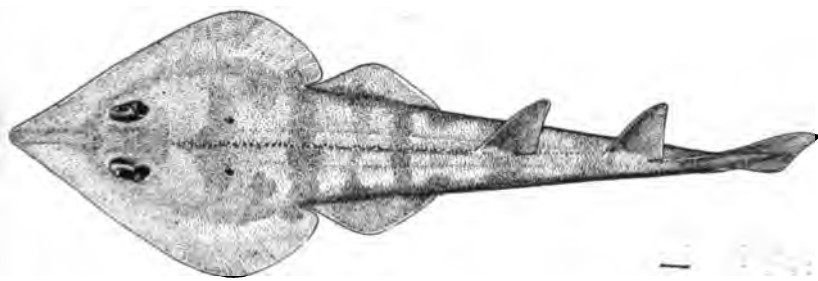
11



1. *MUSTELUS DORSALIS* GILL. (PAGE 7.)

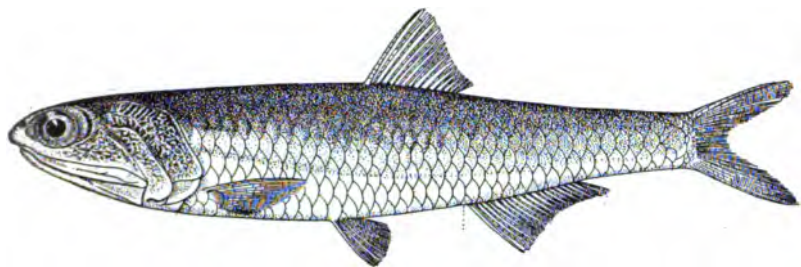


2. *MUSTELUS NIGROMACULATUS*. FROM THE TYPE. (PAGE 9.)

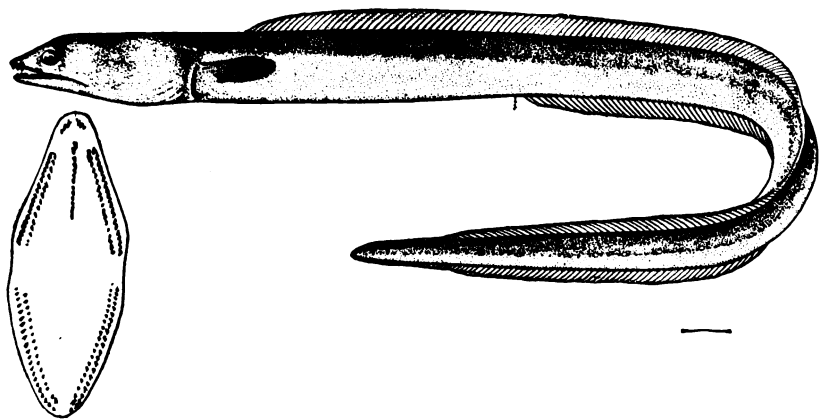


3. *RHINOBATUS PLANICEPS* GARMAN. (PAGE 12.)

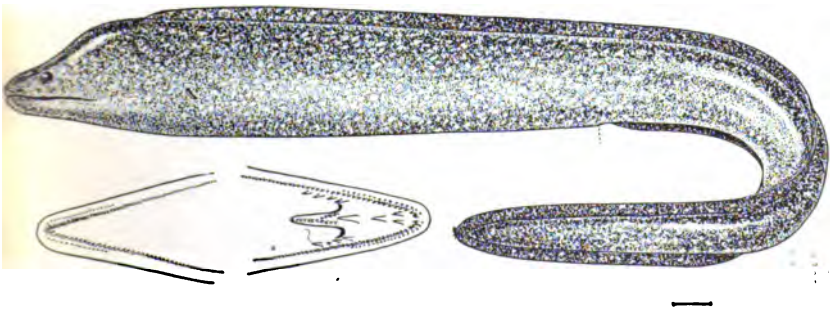
44



1. ENGRAULIS RINGENS JENYNS. (PAGE 23.)

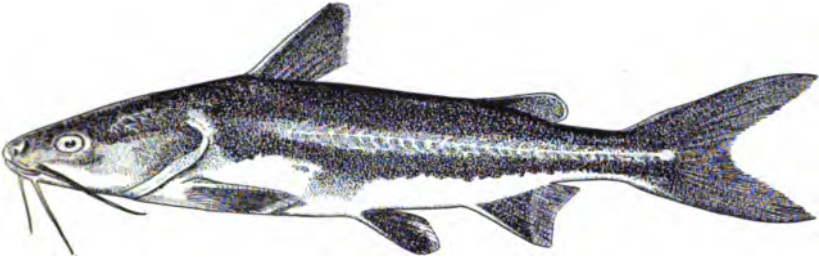


2. OPHICHTHUS PACIFICI (GÜNTHER). (PAGE 25.)

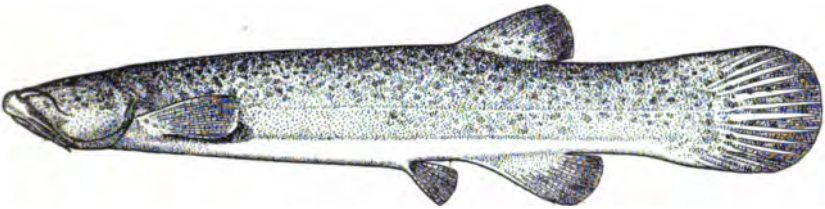


3. GYMNOTHORAX WIENERI (SAUVAGE). (PAGE 26.)

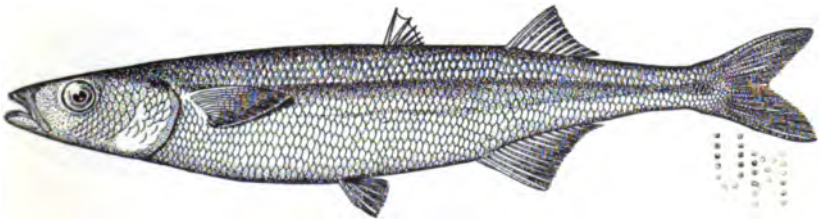
4



1. *GALEICHTHYS PERUVIANUS* LÜTKEN. (PAGE 31.)

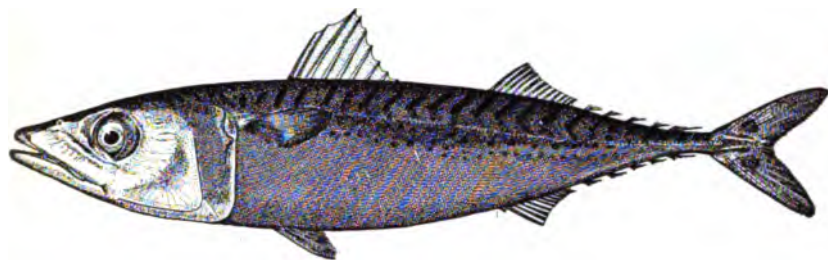


2. *PYGIDIUM OROYAE* EIGENMANN AND EIGENMANN. (PAGE 35.)

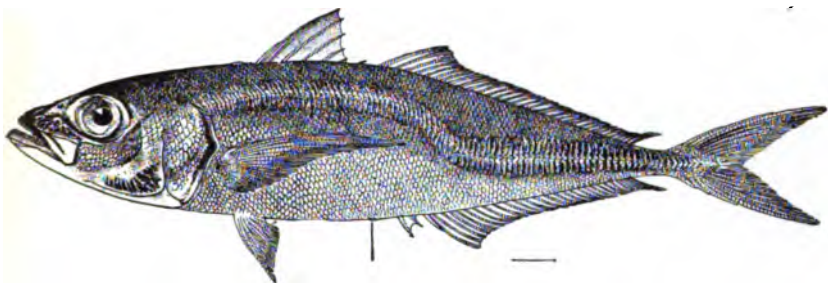


3. *BASILICHTHYS AFFINIS* (STEINDACHNER). (PAGE 47.)

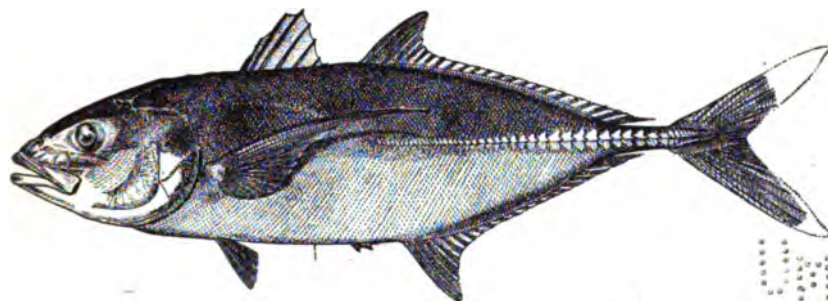
Digitized by Google



1. *SCOMBER JAPONICUS* HOUTTUYN. (PAGE 54.)

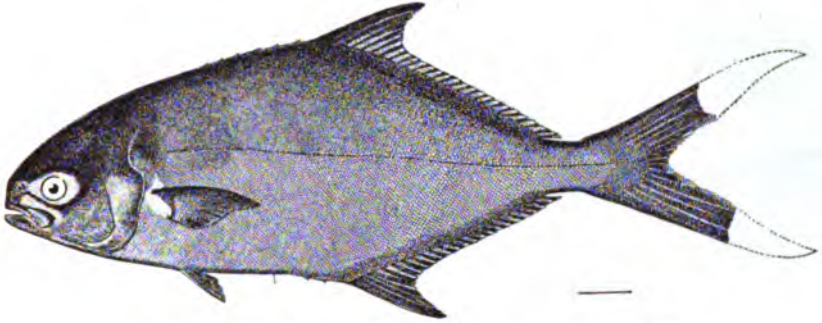


2. *TRACHURUS SYMMETRICUS* (AYRES). (PAGE 59.)

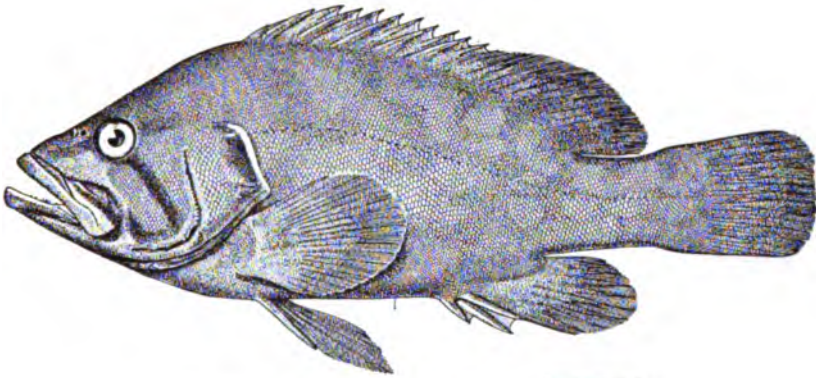


3. *CARANX CABALLUS* (GÜNTHER). (PAGE 61.)

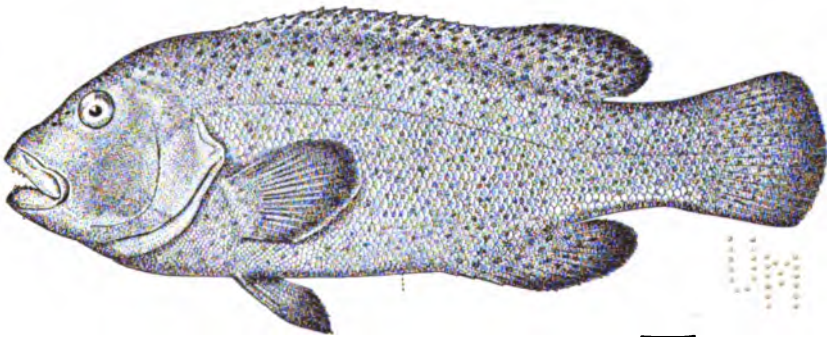




1. *TRACHINOTUS PALOMA* JORDAN AND STARKS. (PAGE 62.)

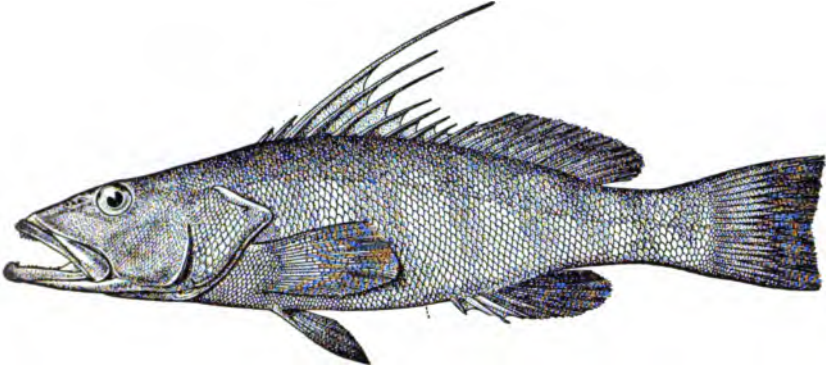


2. *ACANTHISTIUS PICTUS* (TSCHUDI). (PAGE 66.)

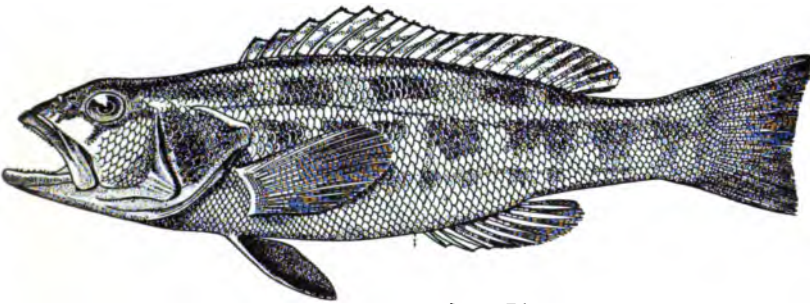


3. *EPELYTES PUNCTATUS*. FROM THE TYPE. (PAGE 71.)

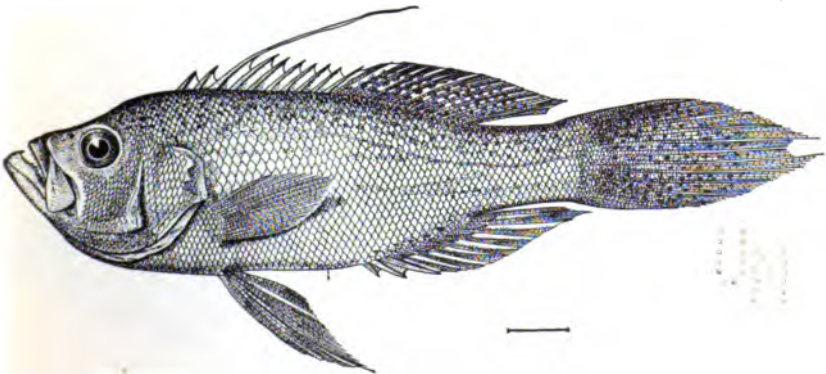
5



1. *CRATINUS AGASSIZII* STEINDACHNER. (PAGE 72.)

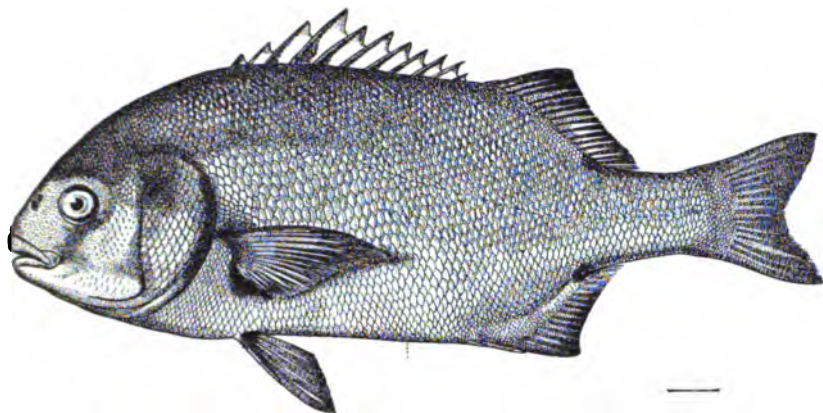


2. *DIPLECTRUM CONCEPTIONE* (CUVIER AND VALENCIENNES). (PAGE 75.)

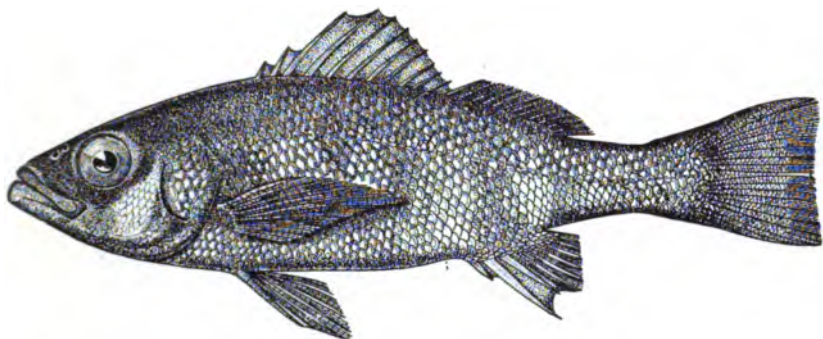


3. *HEMIANTHIAS PERUANUS* STEINDACHNER. (PAGE 79.)

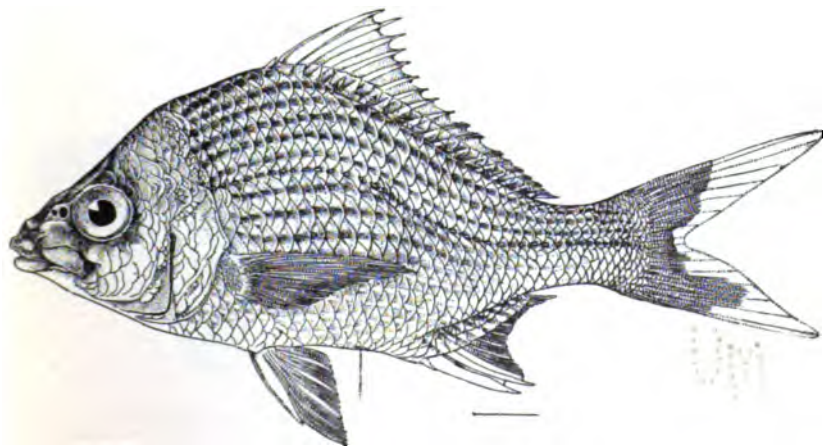
11



1. *ANISOTREMUS SCAPULARIS* (TSCHUDI). (PAGE 81.)

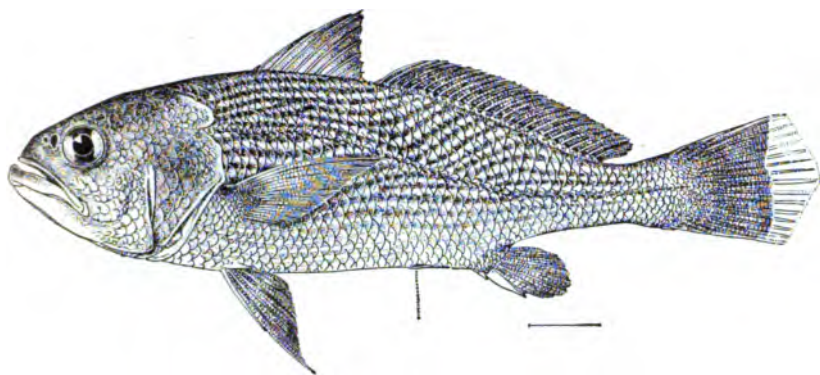


2. *CONODON SERRIFER* JORDAN AND GILBERT. (PAGE 82.)

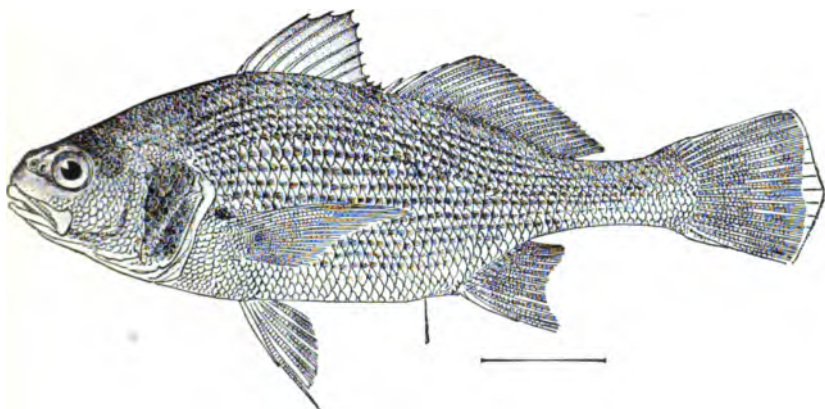


3. *GERRES PERICHE*. FROM THE TYPE. (PAGE 93.)

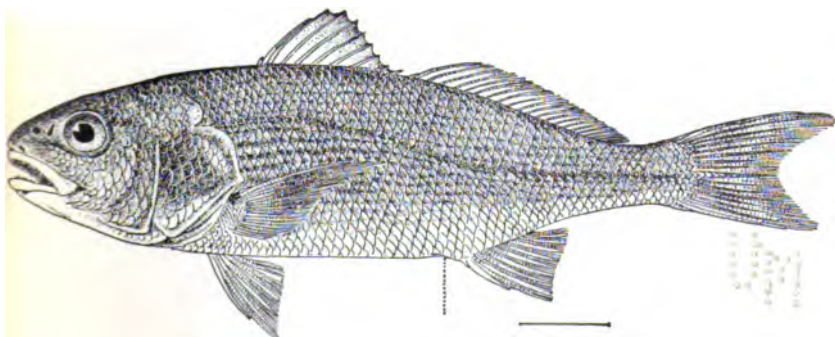
Digitized by Google



1. *LARIMUS PACIFICUS* JORDAN AND BOLLMAN. (PAGE 98.)

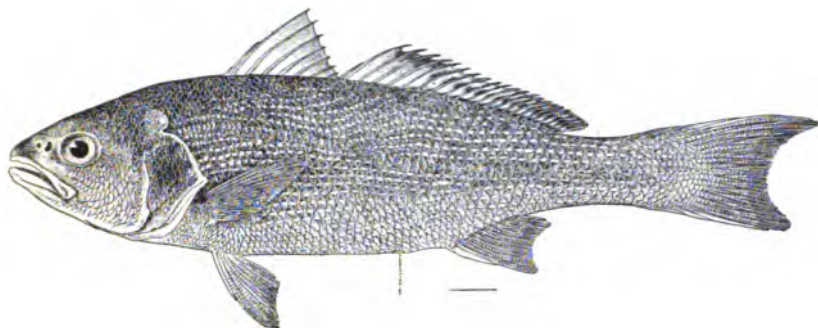


2. *STELLIFER MINOR* (TSCHUDI). (PAGE 99.)

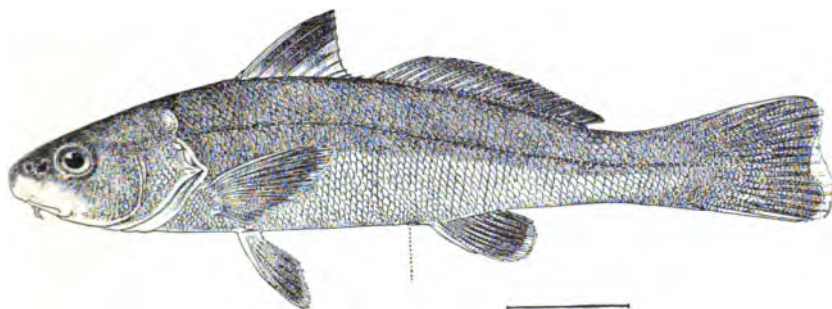


3. *SCIAENA DELICIOSA* (TSCHUDI). (PAGE 102.)

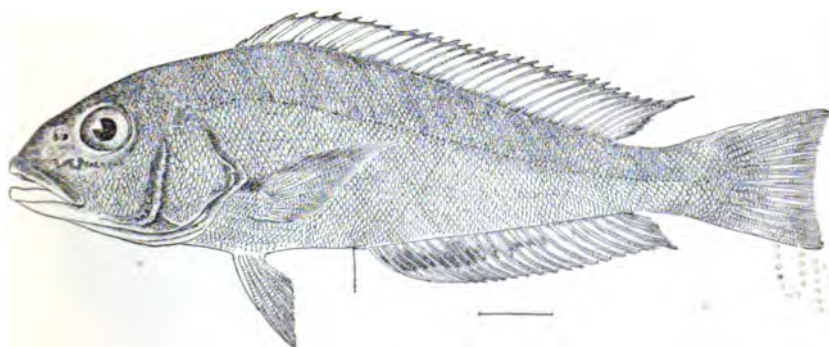
44



1. *SCIAENA GILBERTI* ABBOTT. (PAGE 103.)

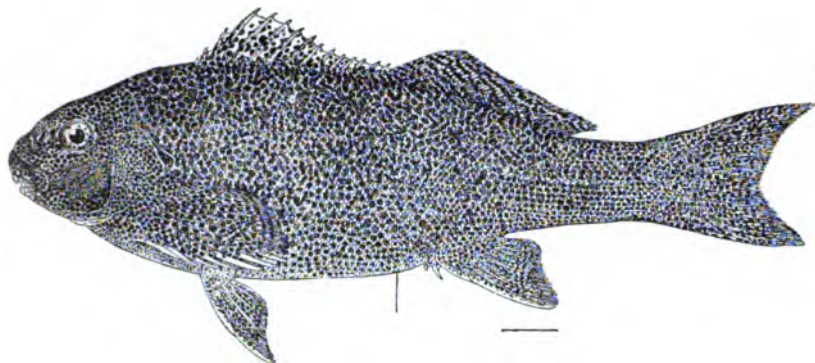


2. *MENTICIRRHUS COKERI*. FROM THE TYPE. (PAGE 107.)

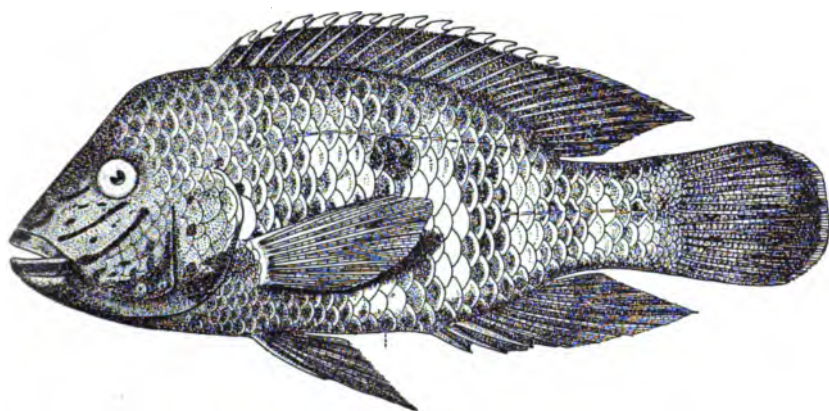


3. *CAULOLATILUS CABEZON*. FROM THE TYPE. (PAGE 111.)

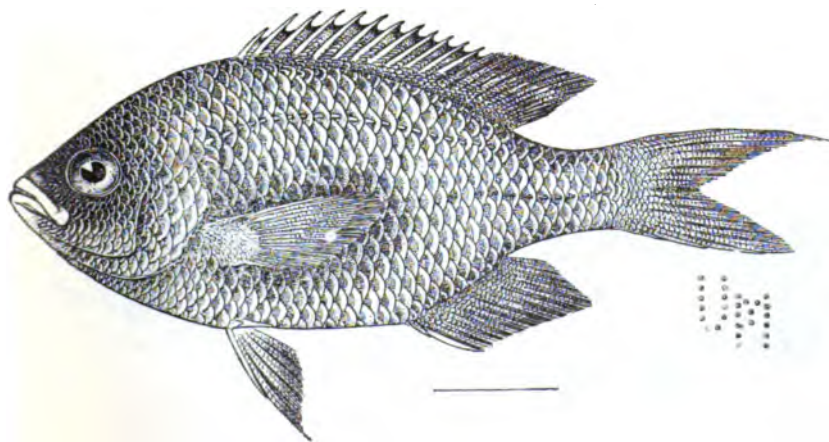




1. *APLODACTYLUS PUNCTATUS* CUVIER AND VALENCIENNES. (PAGE 115.)

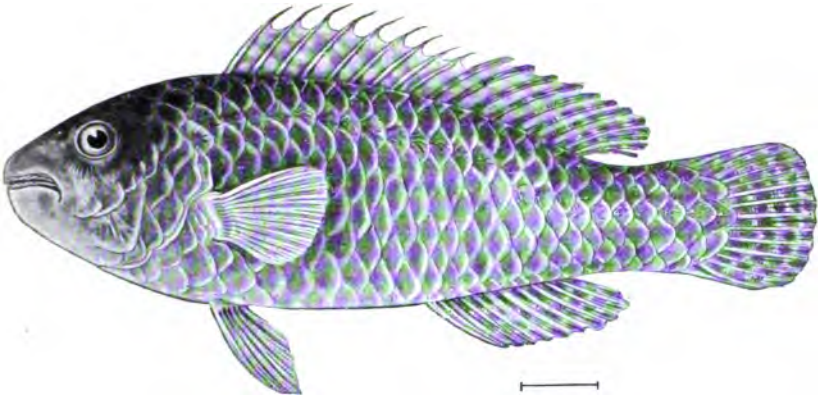


2. *AEQUIDENS RIVULATUS* (GÜNTHER). (PAGE 116.)

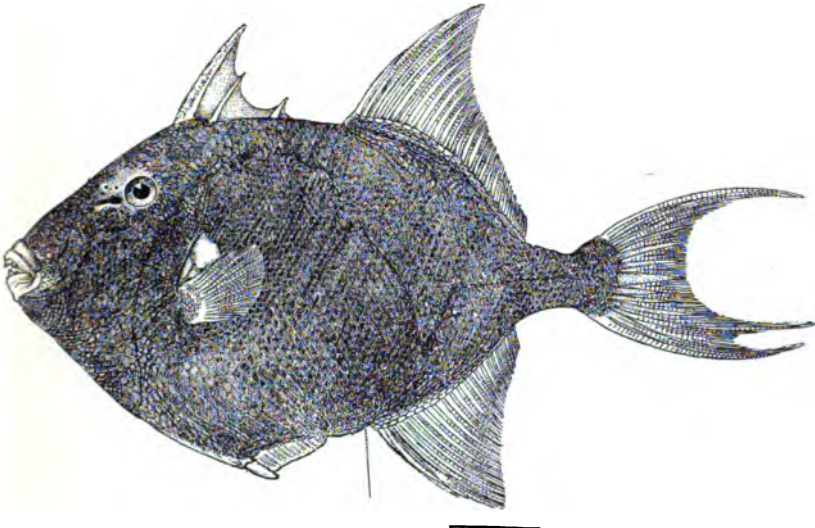


3. *CHROMIS INTERCRUSMA*. FROM THE TYPE. (PAGE 119.)

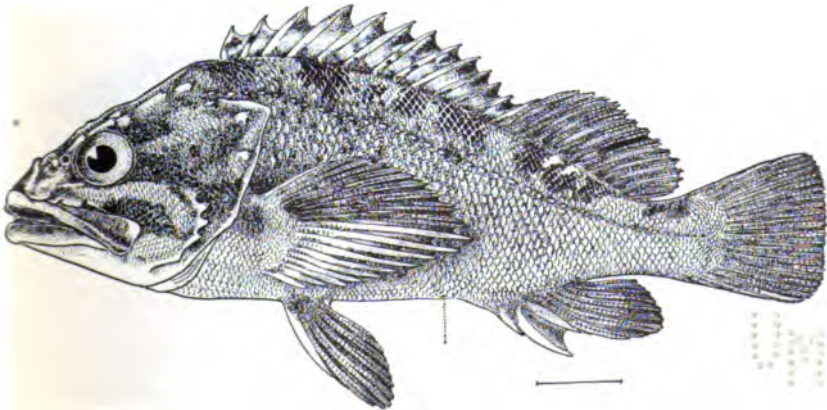




1. *XENOSCARUS DENTICULATUS*. FROM THE TYPE. (PAGE 129.)

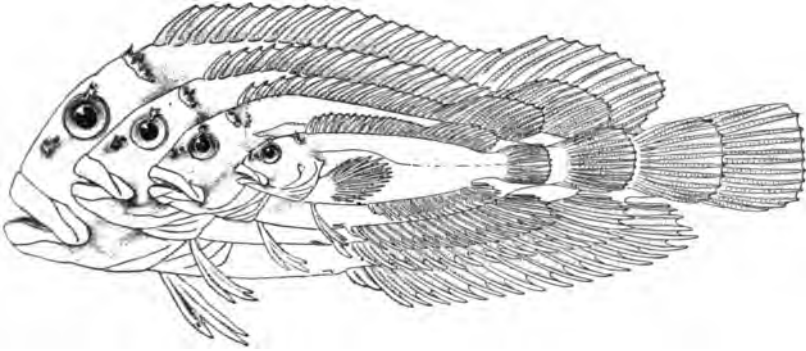


2. *BALISTES POLYLEPIS* STEINDACHNER. (PAGE 131.)

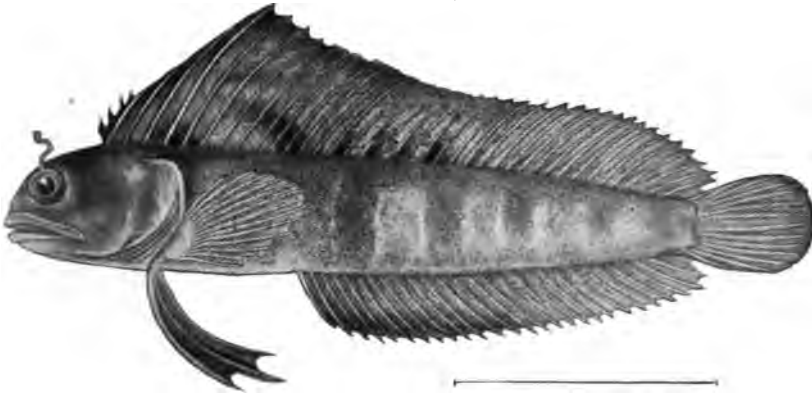


3. *SEBASTICHTHYS CHAMACO*. FROM THE TYPE. (PAGE 136.)

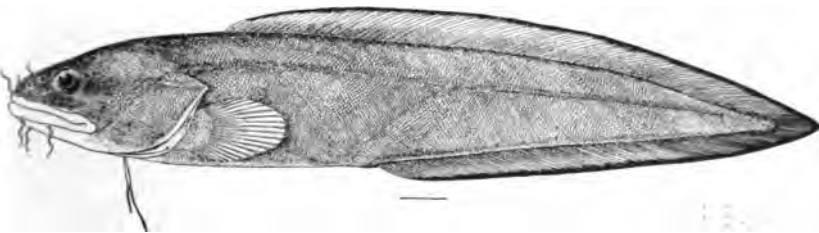




1. *LEPISOMA PHILIPPI* (STEINDACHNER). (PAGE 144.)

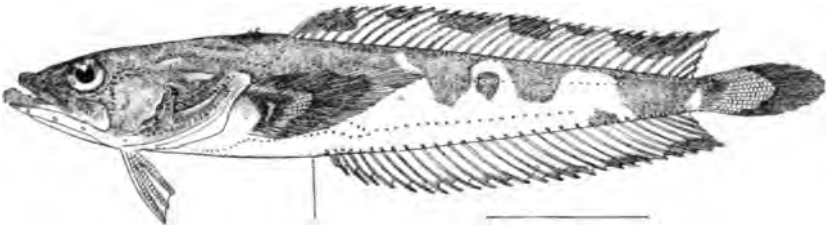


2. *EMBLEMARIA HUDSONI*. FROM THE TYPE. (PAGE 147.)

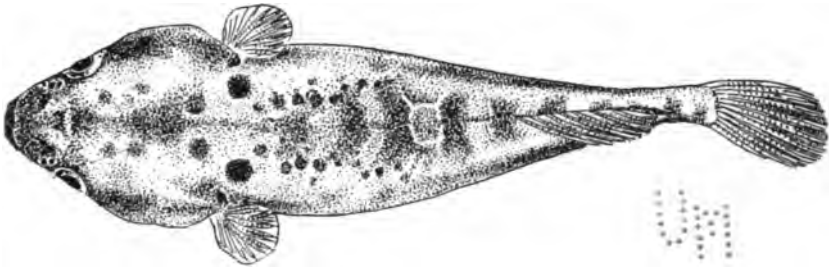


3. *BROTULA MACULATA*. FROM THE TYPE. (PAGE 151.)

2000



1. *PORICHTHYS AFUERÆ*. FROM THE TYPE. (PAGE 152.)



2. *ARBACIOSA HIEROGLYPHICA*. FROM THE TYPE. (PAGE 155.)



# INDEX.

	Page.		Page.
abbotti, <i>Mustelus</i> .....	6, 9, 10	<i>Ancylodon altipinnis</i> .....	96
<i>Abudefduf</i> .....	123	angulosus, <i>Canthidermis</i> .....	131, 132
marginatus.....	123	<i>Anisotremus</i> .....	80
saxatilis.....	123	pacifici.....	80
<i>Acanthistius</i> .....	66	(Paraconodon) pacifici.....	81
pictus.....	66	scapularis.....	81
<i>Acara pulchra</i> .....	116	annulatus, <i>Spheroides</i> .....	132
rivulata.....	116	<i>Tetrodon</i> .....	132
acclivis, <i>Larimus</i> .....	99	antarctica, <i>Chimaera</i> .....	18
aciculare, <i>Siphostoma</i> .....	53	antarcticus, <i>Callorhynchus</i> .....	18
acicularis, <i>Syngnathus</i> .....	53	<i>Anthias</i> ( <i>Hemianthias</i> ) peruanus.....	79
adpersus, <i>Balistes</i> .....	131, 132	peruanus.....	79
<i>Canthidermis</i> .....	131	<i>Aplocheilus</i> .....	37
<i>Paralichthys</i> .....	140	peruanus.....	37
<i>Pseudorhombus</i> .....	140	<i>Aplodactylus</i> .....	115
<i>Aequidens</i> .....	116	guttatus.....	115
rivulatus.....	116, 117	punctatus.....	115
affine, <i>Ohiostoma</i> .....	47	reginae.....	115
affinis, <i>Baslichthys</i> .....	47	vermiculatus.....	115
afrum, <i>Plectropoma</i> .....	69	approximans, <i>Polydactylus</i> .....	52
afueræ, <i>Porichthys</i> .....	152	<i>Polynemus</i> .....	52
agassizii, <i>Corvina</i> .....	99	<i>Arbacia</i> .....	155
<i>Corvina</i> ( <i>Homoprion</i> ).....	99	hieroglyphica.....	155
<i>Cratinus</i> .....	72	petersii.....	156
<i>Orestias</i> .....	40	pyrrhocincla.....	155, 156
<i>Serranus</i> .....	72	pyrrhocinclus.....	155
<i>Stellifer</i> .....	99	archæus, <i>Gastropterus</i> .....	45, 46, 47
<i>Agriopus</i> .....	139	<i>Archoscion altipinnis</i> .....	96
peruanus.....	139	analis.....	96
peruvianus.....	139	peruanus.....	96
aguja, <i>Raja</i> .....	14	<i>Arges simonstii</i> .....	37
<i>Alausa fimbriata</i> .....	20	asper, <i>Labrus</i> .....	127
albemarleus, <i>Nexilosus</i> .....	121, 123	asperrimus, <i>Myliobatis</i> .....	17
albus, <i>Orestias</i> .....	42	<i>Astyanax</i> .....	27
<i>Alphastes</i> .....	69	peruanus.....	27, 28, 117
multiguttatus.....	69, 70	<i>Atherina regia</i> .....	45
pictus.....	66	microlepidota.....	45, 46
<i>Alticus</i> .....	146	<i>Atherinopsis</i> .....	45
gigas.....	146	californiensis.....	46
altipinnis, <i>Ancylodon</i> .....	96	regius.....	45, 46, 48
<i>Archoscion</i> .....	96	atricaudatus, <i>Brycon</i> .....	27
<i>Cynoscion</i> .....	96	Chalceus.....	27
<i>Amblyopus broussonetii</i> .....	134	atrilobata, <i>Chromis</i> ( <i>Furcaria</i> ).....	117
( <i>Gobioides</i> ) peruanus.....	134	atrilobatus, <i>Chromis</i> .....	117
<i>Amia</i> .....	64	<i>Auchenionchus crinitus</i> .....	145
dovii.....	65	australis, <i>Gadus</i> .....	156
retrosella.....	64	Galeus.....	8
analis, <i>Archoscion</i> .....	96	bairdii, <i>Orestias</i> .....	39
<i>Cynoscion</i> .....	96	<i>Balistes</i> .....	131
<i>Isopisthus</i> .....	96	adpersus.....	131, 132
<i>Otolithus</i> .....	96	naufragium.....	131
<i>Umbrina</i> .....	106	polylepis.....	131
<i>Anchisomus geometricus</i> .....	132	barbata, <i>Brotula</i> .....	152

	Page.		Page.
barbatula, Trichomycterus.....	34	Caulolatilus.....	110
Basileichthys affinis.....	47	cabezon.....	111
jordanii.....	47, 48, 49	princeps.....	110
octavius.....	48, 49	Centrolophus peruanus.....	63
regillus.....	47, 48, 49	cephalus, Mugil.....	49, 117
beardslee, Gastropterus.....	45	Chaetodon saxatilis.....	123
Pisciregia.....	45, 46	Chaetostoma lobarhynchus.....	37
Belone stolzmanni.....	43	Chaetostomus.....	37
bimaculata, Lebiasina.....	29, 117	loborhynchus.....	37
blacodes, Genypterus.....	149, 150, 151	chaliceum, Pristipoma.....	57
Oplidium.....	149	Chalceus atricaudatus.....	27
blainvilliei, Leptonotus.....	53	chalceus, Orthopristis.....	87, 88
blainvilliana, Siphostoma.....	53	chamaco, Sebastichthys.....	136
blainvillianus, Leptonotus.....	53	charlottae, Mugil.....	50
Syngnathus.....	53	Chelodactylus.....	113
(Leptonotus).....	53	cinctus.....	113
Blennius.....	146	variegatus.....	113
(Hypleurochilus) paytensis.....	146	Chelotrema fasciatum.....	101
tetranemus.....	146	chilense, Scyllium.....	3
Bodianus.....	123	chilensis, Esox.....	112
diplotaenius.....	124, 125, 127	Exocoetus.....	44
eclancheri.....	125, 127	Genypterus.....	150, 151
boops, Caranx.....	61	Halaelurus.....	3
Brachydeuterus.....	83	Pelamys.....	56
leuciscus.....	84	Pinguipes.....	112
nitidus.....	83	Sarda.....	56
branicki, Pomadasis.....	86	Scylliorhinus.....	3
Pristipoma.....	86	Chimaera antarctica.....	18
brevicaudatus, Psammobatis.....	16	callorhynchus.....	18
brevimanus, Gerres.....	94	Chirostoma affine.....	47
brevirostris, Gobiesox.....	153	Chromis.....	117
Brotula.....	151	atrilobatus.....	117
barbata.....	152	crusma.....	118, 121
maculata.....	151	(Furcaria) atrilobata.....	117
broussonetii, Amblyopus.....	134	intercrusma.....	119, 120
Gobioides.....	136	rivulata.....	116
Brycon.....	27	Chrysophrys cyanoptera.....	91
atricaudatus.....	27	taurina.....	91
burgeri, Raja.....	14	chrysops, Latilus.....	112
burro, Pomadasis.....	86	ciliilabris, Myxus.....	51
caballus, Caranx.....	61	Neomyxus.....	51
cabezon, Caulolatilus.....	111	cinctus, Chelodactylus.....	113
Calamus.....	91	cinereum, Xystaema.....	91, 92
taurinus.....	91	Citharichthys.....	141
californica, Squatina.....	11	gilberti.....	141
californicus, Myliobatis.....	17	Clinus fortidentatus.....	144
californiensis, Atherinopsis.....	46	microcirrhus.....	146
callaensis, Ophichthus.....	25	peruvianus.....	145
Paralabrax.....	74, 75	philippi.....	144
Callorhynchus.....	18	Clupanodon fimbriata.....	20
antarcticus.....	18	fimbriatus.....	20
callorhynchus.....	18	sagax.....	20
callorhynchus, Callorhynchus.....	18	Clupea (Alosa) notacanthoides.....	19
Chimaera.....	18	notacanthus.....	19
cantharinus, Orthopristis.....	88	sagax.....	20
Canthidermis.....	131	stolifera.....	21
adpersus.....	131	cockeri, Menticirrhus.....	107
angulosus.....	131, 132	colias, Scomber.....	54
Caranx.....	61	conceptione, Diplectrum.....	75
boops.....	61	conceptionis, Isacia.....	89
caballus.....	61	Pristipoma.....	89
girardi.....	61	Serranus.....	75
peruanus.....	62	Conodon.....	83
scombrinus.....	58	nobilis.....	83
symmetricus.....	59	pacifici.....	81
(Trachurus) cuvieri.....	59	plumieri.....	82

	Page.		Page.
Conodon, serrifer.....	82	eclancheri, Harpe.....	125
Corvina agassizii.....	99	ectenes, Etropus.....	142
deliciosa.....	102	edulis, Mustelus.....	6
fasciata.....	101	elegans, Orestias.....	40
(Homoprion) agassizii.....	99	Emblemaria.....	147
minor.....	99, 100	hudsoni.....	147
Cossyphus darwini.....	127	nivipes.....	148
eclancheri.....	125	Engraulis.....	23
crassus, Neptomenus.....	57	nasus.....	24
Cratinus.....	72	peruanus.....	23
agassizii.....	72	ringens.....	23, 24
crebripunctata, Pteroplatea.....	16	tapirulus.....	23
cretense, Sparisoma.....	129	Epelytes.....	71
crinitus, Auchenionchus.....	145	punctatus.....	71
Lepisoma.....	146	Epicopus gayi.....	156
crusma, Chromis.....	118, 121	Epinephelus.....	59
Heliases.....	118, 120	labriformis.....	69
Heliastes.....	118	multiguttatus.....	70
cuvieri, Caranx (Trachurus).....	59	xenarchus.....	70
Orestias.....	38	equatorialis, Tachysurus.....	32
cuvieri, Orestias.....	38	Esox chilensis.....	112
cyanoptera, Chrysophrys.....	91	Etropus.....	142
Cycloptum simonsii.....	37	ectenes.....	142
Cynoscion.....	96	Eupomacentrus latifrons.....	121
altipinnis.....	96	exiliens, Exocoetus.....	44
analis.....	96	Exocoetus.....	44
peruanus.....	96	chilensis.....	44
phoxocephalum.....	97	exiliens.....	44
phoxocephalus.....	97	exsiliens.....	44
stolzmanni.....	97	rufipinnis.....	44
Cypsilurus.....	44	speculiger.....	44
speculiger.....	44	volitans.....	44
darwini, Sebastodes.....	137	Exoglossum.....	153
darwini, Cossyphus.....	127	exsiliens, Exocoetus.....	44
Pimelometopon.....	127	fasciata, Corvina.....	101
Trochocopus.....	127	Sciaena.....	110
Decapterus.....	58	fasciatum, Cheliotrema.....	101
sanctaeelenaee.....	59	Doydixodon.....	94
scombrinus.....	58, 59	fasciatus, Oplegnathus.....	110
Decapturus scombrinus.....	58	Prionodes.....	77
deliciosa, Corvina.....	102	fimbriata, Alausa.....	20
Sciaena.....	102	Clupanodon.....	20
denticulatus, Xenoscarus.....	129	Sardinella.....	20
Diplectrum.....	75	fimbriatus, Clupanodon.....	20
conceptione.....	75	fortidentatus, Clinus.....	144
diplotaenia, Harpe.....	124	francisci, Gyropleurodus.....	3
diplotaenius, Bodianus.....	124, 125, 127	freminvillei, Doydixodon.....	95
Discopyge.....	16	frontosus, Orestias.....	43
tschudii.....	16	furcifer, Serranus.....	78
dispar, Pygidium.....	35	furcifer, Pontinus.....	138
Trichomycterus.....	34	gabonensis, Vomer.....	62
var, punctulatum, Pygidium.....	36	Gadus australis.....	156
dispersus, Paralichthys.....	141	Galeichthys.....	30
dispilus, Iridio.....	128	jordanii.....	31, 32
Platygllossus.....	128	peruvianus.....	31
dorsalis, Mustelus.....	67	simonsi.....	31
dovii, Amia.....	65	Galeorhinus mento.....	6
Doydixodon.....	94	zyopterus.....	10
fasciatum.....	94	Galeus.....	10
freminvillei.....	95	australis.....	8
laevifrons.....	94	dorsalis.....	6, 7
dubius, Pontinus.....	138	mento.....	6
Echenels.....	135	zyopterus.....	10
remora.....	135	Gastropterus archaeus.....	45, 46, 47
eclancheri, Bodianus.....	125, 127	beardsleel.....	45
Cossyphus.....	125	gayi, Epicopus.....	156

	Page.		Page.
<i>gayi</i> , <i>Merluccius</i> .....	156	<i>Hypleurochilus</i> .....	146
<i>Merluccius</i> .....	156	<i>paytensis</i> .....	146
<i>Merlus</i> .....	156	<i>Hyporhamphus</i> .....	43
<i>Genyanemus peruanus</i> .....	108	<i>unifasciatus</i> .....	43
<i>Genypterus</i> .....	149	<i>idiastes</i> , <i>Sphyræna</i> .....	51
<i>blacodes</i> .....	149, 150, 151	<i>illecebrosus</i> , <i>Stellifer</i> .....	100
<i>chilensis</i> .....	150, 151	<i>incæ</i> , <i>Orestias</i> .....	42
<i>nigricans</i> .....	150	<i>Trichomycterus</i> .....	34
<i>geometricus</i> , <i>Anchisomus</i> .....	132	<i>insigne</i> , <i>Oplegnathus</i> .....	109
<i>Gerres</i> .....	92	<i>Scarostoma</i> .....	109
<i>brevimanus</i> .....	94	<i>insignis</i> , <i>Oplegnathus</i> .....	109
<i>lineatus</i> .....	93	<i>insignis</i> , <i>Oplegnathus</i> .....	109
<i>periche</i> .....	93	<i>intercrasma</i> , <i>Chromis</i> .....	119, 120
<i>peruvianus</i> .....	92	<i>Iridio dispilus</i> .....	128
<i>similifrons</i> .....	91	<i>Isacia</i> .....	89
<i>gigas</i> , <i>Aldicus</i> .....	146	<i>conceptionis</i> .....	89
<i>Salarias</i> .....	146	<i>venusta</i> .....	89
<i>Scartichthys</i> .....	146	<i>Isopisthus analis</i> .....	96
<i>gilberti</i> , <i>Citharichthys</i> .....	141	<i>japonicus</i> , <i>Scomber</i> .....	54
<i>Sciaena</i> .....	103, 104, 105	<i>jenkinsi</i> , <i>Lepisoma</i> .....	145
<i>gilli</i> , <i>Rhamdia</i> .....	33	<i>jordani</i> , <i>Basileichthys</i> .....	47, 48, 49
<i>girardi</i> , <i>Caranx</i> .....	61	<i>Galeichthys</i> .....	31, 32
<i>gladius</i> , <i>Xiphias</i> .....	56	<i>jussiei</i> , <i>Orestias</i> .....	42
<i>Xiphias</i> .....	56	<i>jussiei</i> , <i>Orestias</i> .....	42
<i>Glyphidodon latifrons</i> .....	121	<i>labriformis</i> , <i>Epinephelus</i> .....	69
<i>Glyphisodon saxatilis</i> .....	123	<i>Serranus</i> .....	69
<i>Gobiesox</i> .....	153	<i>Labrisomus microcirrhis</i> .....	146
<i>brevirostris</i> .....	153	<i>philippi</i> .....	144
<i>marmoratus</i> .....	155	<i>xanti</i> .....	143
<i>sanguineus</i> .....	153	<i>Labrosomus xanti</i> .....	143
<i>Gobioides broussoneti</i> .....	134, 135	<i>Labrus asper</i> .....	127
<i>peruanus</i> .....	134, 135	<i>laevifrons</i> , <i>Doydixodon</i> .....	94
<i>Gobius soporator</i> .....	134	<i>Pimelepterus</i> .....	94
<i>gracilis</i> , <i>Trichomycterus</i> .....	34	<i>Larimus</i> .....	98
<i>grandimaculatus</i> , <i>Ophichthys</i> .....	24	<i>acclivis</i> .....	99
<i>guttatus</i> , <i>Aplodactylus</i> .....	115	<i>pacificus</i> .....	98
<i>Gymnothorax</i> .....	26	<i>lateralis</i> , <i>Philypnus</i> .....	133
<i>wieneri</i> .....	26	<i>laticeps</i> , <i>Pygidium</i> .....	35
<i>Gyropleurodus francisci</i> .....	3	<i>latifrons</i> , <i>Eupomacentrus</i> .....	121
<i>peruanus</i> .....	2	<i>Glyphidodon</i> .....	121
<i>quoyi</i> .....	3	<i>Nexilosus</i> .....	121
<i>Haemulon modestum</i> .....	88	<i>Pomacentrus</i> .....	121
<i>Halaelurus</i> .....	3	<i>Latilus chrysops</i> .....	112
<i>chilensis</i> .....	3	<i>princeps</i> .....	110
<i>Halichoeres</i> .....	120	<i>Lobiasina</i> .....	29
<i>Haplocheilichthys peruanus</i> .....	37	<i>bimaculata</i> .....	29, 117
<i>Haplodactylus punctatus</i> .....	115	<i>Lelrus</i> .....	63
<i>Harengula</i> .....	21	<i>peruanus</i> .....	63
<i>moluccensis</i> .....	22	<i>Lembus maculatus</i> .....	133
<i>stolifera</i> .....	21	<i>Lepisoma</i> .....	143
<i>Harpe diplotaenia</i> .....	124	<i>crinitus</i> .....	146
<i>eclancheri</i> .....	125	<i>jenkinsi</i> .....	145
<i>Hellases crasma</i> .....	118, 120	<i>microcirrhis</i> .....	146
<i>Heliastes crasma</i> .....	118	<i>peruviana</i> .....	145
<i>Hemianthias</i> .....	79	<i>philippi</i> .....	144, 145, 146
<i>peruanus</i> .....	79	<i>variolosus</i> .....	145, 146
<i>Hemiflutjanus</i> .....	67	<i>xanti</i> .....	143, 144, 147
<i>macrophthalmos</i> .....	67	<i>Leptocephalus</i> .....	24
<i>paytensis</i> .....	75	<i>multimaculatus</i> .....	24
<i>Hemirhamphus unifasciatus</i> .....	43	<i>peruanus</i> .....	24
<i>hieroglyphica</i> , <i>Arbacia</i> .....	155	<i>Leptonotus blainvilliei</i> .....	53
<i>histrio</i> , <i>Scorpaena</i> .....	137	<i>blainvilliani</i> .....	53
<i>Holorhinus vespertilio</i> .....	17	<i>leuciscus</i> , <i>Brachydeuterus</i> .....	84
<i>huascarii</i> , <i>Prionodes</i> .....	78	<i>var. elongatus</i> , <i>Pristipoma</i> .....	84
<i>hudsoni</i> , <i>Emblemaria</i> .....	147	<i>Pomadasis</i> .....	84
<i>humeralis</i> , <i>Paralabrax</i> .....	73, 75	<i>leuciscus</i> , <i>Pristipoma</i> .....	84
<i>Serranus</i> .....	73	<i>lineatus</i> , <i>Gerres</i> .....	93, 94
		<i>Lirus peruanus</i> .....	63

	Page.		Page.
<i>liza</i> , Mugil.....	50	<i>naufragium</i> , Balistes.....	131
<i>loborhynchus</i> , Chaetostoma.....	37	<i>Neomoxus</i> .....	51
<i>Chaetostomus</i> .....	37	<i>clililabls</i> .....	51
<i>luteus</i> , Orestias.....	42	<i>Neptomenus</i> .....	57
<i>Lycodontis wieneri</i> .....	26	<i>crassus</i> .....	57
<i>macracanthus</i> , Pomadasis.....	86	<i>neveui</i> , Orestias.....	42
<i>macrophthalmos</i> , Hemilutjanus.....	67	<i>Nexillosus</i> .....	121
<i>Plectropoma</i> .....	67	<i>albemarleus</i> .....	121, 123
<i>Pomodon</i> .....	68	<i>latifrons</i> .....	121
<i>maculata</i> , Brotula.....	151	<i>nigricans</i> , Genypterus.....	150
<i>maculatum</i> , Ophidium.....	149	<i>nigromaculatus</i> , Mustelus.....	9
<i>maculatus</i> , Lembus.....	133	<i>nitidum</i> , Pristipoma ( <i>Haemulopsis</i> ).....	83
<i>Philypnus</i> .....	133	<i>nitidus</i> , Brachydeuterus.....	83
<i>Stromateus</i> .....	64	<i>Pomadasis</i> .....	83
<i>malleus</i> , Zygaena.....	5	<i>nivipes</i> , Emblemaria.....	148
<i>Mapo</i> .....	134	<i>nobilis</i> , Conodon.....	83
<i>soporator</i> .....	134	<i>notacanthoides</i> , Clupea ( <i>Alosa</i> ).....	19
<i>margaritatus</i> , Porichthys.....	152	<i>Potomalos</i> .....	19
<i>marginatus</i> , Abudoduf.....	123	<i>notachanthus</i> , Clupea.....	19
<i>marmoratus</i> , Gobiesox.....	155	<i>octavius</i> , Basilichthys.....	48, 49
<i>mediterraneus</i> , Trachurus.....	60	<i>oculata</i> , Sebastes.....	137
<i>Menticirrhus</i> .....	106	<i>Sebastichthys</i> .....	137
<i>cokeri</i> .....	107	<i>olivaceus</i> , Orestias.....	42
<i>panamensis</i> .....	106, 107	<i>Ophichthys</i> .....	24
<i>mento</i> , Galeorhinus.....	6	<i>callaensis</i> .....	25
<i>Mustelus</i> .....	6	<i>grandimaculatus</i> .....	24
<i>Merluccias gayi</i> .....	156	<i>pacifici</i> .....	25, 26
<i>productus</i> .....	157	<i>uniserialis</i> .....	25, 26
<i>Merluccius</i> .....	156	<i>Ophichthys callaensis</i> .....	25
<i>gayi</i> .....	156	<i>uniserialis</i> .....	25
<i>Merlus gayi</i> .....	156	<i>Ophidium blacodes</i> .....	149
<i>mexicanus</i> , Mugil.....	50	<i>blancodes</i> .....	149
<i>microcirrhls</i> , Clinus.....	146	<i>maculatum</i> .....	149
<i>Labrisomus</i> .....	146	<i>Oplegnathus</i> .....	109
<i>Lepisoma</i> .....	146	<i>fasciatus</i> .....	110
<i>microlepidota</i> , Atherina.....	45, 46	<i>insigne</i> .....	109
<i>microphthalmus</i> , Tetragonopterus.....	28	<i>insignis</i> .....	109
<i>minor</i> , Corvina.....	99, 100	<i>insignus</i> .....	109
<i>Scaena</i> .....	99	<i>Orestias</i> .....	37
<i>Stellifer</i> .....	99	<i>agassizii</i> .....	40
<i>Stelliferus</i> .....	99	<i>albus</i> .....	42
<i>modestum</i> , Haemulon.....	88	<i>balrdii</i> .....	39
<i>modestus</i> , Orthoprists.....	88	<i>cuvieri</i> .....	38, 39
<i>moluccensis</i> , Harengula.....	22	<i>cuvierii</i> .....	38
<i>Mugil</i> .....	49	<i>elegans</i> .....	40
<i>cephalus</i> .....	49, 117	<i>frontosus</i> .....	40
<i>charlottae</i> .....	50	<i>incae</i> .....	42
<i>liza</i> .....	50	<i>jussiei</i> .....	42
<i>mexicanus</i> .....	50	<i>jussieui</i> .....	42
<i>rammelsbergii</i> .....	50	<i>luteus</i> .....	42
<i>mulleri</i> , Orestias.....	40	<i>mulleri</i> .....	40
<i>multiguttatum</i> , Plectropoma.....	69	<i>neveui</i> .....	42
<i>multiguttatus</i> , Alphestes.....	69, 70	<i>olivaceus</i> .....	42
<i>multimaculatus</i> , Leptocephalus.....	24	<i>ortonii</i> .....	40
<i>Mustelus</i> .....	5	<i>owenii</i> .....	42
<i>abbotti</i> .....	6, 9, 10	<i>pentlandii</i> .....	39
<i>dorsalis</i> .....	6, 7	<i>tschudii</i> .....	40
<i>edulis</i> .....	6	<i>oroyae</i> , Pygidium.....	35
<i>mento</i> .....	6	<i>Orthoprists</i> .....	87
<i>nigromaculatus</i> .....	9	<i>cantharinus</i> .....	88
<i>Mycteroperca</i> .....	70	<i>chalcus</i> .....	87, 88
<i>xenarcha</i> .....	70	<i>modestus</i> .....	88
<i>Myliobatis</i> .....	17	<i>ortonii</i> , Orestias.....	40
<i>Myliobatis</i> , asperrimus.....	17	<i>Otolithus analis</i> .....	96
<i>californicus</i> .....	17	<i>peruanus</i> .....	96
<i>Myxus clililabls</i> .....	51	<i>stolzmanni</i> .....	97
<i>nasus</i> , Engraulis.....	23	<i>owenii</i> , Orestias.....	42

	Page.		Page.
<i>pacifici</i> , <i>Anisotremus</i> .....	80	<i>phoxocephalum</i> , <i>Cynoscion</i> .....	91
( <i>Paraconodon</i> ).....	81	<i>phoxocephalus</i> , <i>Cynoscion</i> .....	91
<i>Conodon</i> .....	81	<i>Plectropoma macrophthalmos</i> .....	91
<i>Ophichthus</i> .....	25, 26	<i>pictum</i> , <i>Plectropoma</i> .....	91
<i>pacificus</i> , <i>Larimus</i> .....	98	<i>picturatus</i> , <i>Trachurus</i> .....	91
<i>paloma</i> , <i>Trachinotus</i> .....	62	<i>pictus</i> , <i>Acanthistius</i> .....	91
<i>panamensis</i> , <i>Menticirrhus</i> .....	106, 107	<i>Alpheutes</i> .....	91
<i>Umbrina</i> .....	106	<i>Trichomycterus</i> .....	91
<i>pannosa</i> , <i>Scorpeena</i> .....	138	<i>Pimelepterus laevis</i> .....	91
<i>Paralabrax</i> .....	73	<i>Pimelodella</i> .....	91
<i>callaensis</i> .....	74, 75	<i>yuncensis</i> .....	91
<i>humeralis</i> .....	73, 75	<i>Pimelometopon</i> .....	91
<i>Paralichthys</i> .....	140	<i>darwinii</i> .....	91
<i>adpersus</i> .....	140	<i>Pinguipes</i> .....	91
<i>dispersus</i> .....	141	<i>chilensis</i> .....	91
<i>sinaloe</i> .....	140	<i>Pisicregia beardsleeei</i> .....	45, 46, 47
<i>woolmani</i> .....	140	<i>planiceps</i> , <i>Rhinobatus</i> .....	91
<i>pardum</i> , <i>Pygidium</i> .....	36	<i>Platygius delpilus</i> .....	120
<i>paytensis</i> , <i>Blennius</i> ( <i>Hypleurochilus</i> ).....	146	<i>Plectropoma atrum</i> .....	91
<i>Hemilutjanus</i> .....	75	<i>macrophthalmos</i> .....	91
<i>Hypleurochilus</i> .....	146	<i>multiguttatum</i> .....	91
<i>Plectropoma</i> .....	75	<i>paytensis</i> .....	75
<i>Pelamys chilensis</i> .....	55	<i>pictum</i> .....	91
<i>pentlandi</i> , <i>Trichomycterus</i> .....	34	<i>plumieri</i> , <i>Conodon</i> .....	91
<i>pentlandii</i> , <i>Orestias</i> .....	39	<i>poeyanum</i> , <i>Pygidium</i> .....	34
<i>periche</i> , <i>Gerres</i> .....	93	<i>poeyanus</i> , <i>Trichomycterus</i> .....	34
<i>peruana</i> , <i>Seriola</i> .....	58	<i>Polycirrus peruanus</i> .....	106
<i>Zygaena</i> .....	5	<i>Polyclemus</i> .....	106
<i>peruanus</i> , <i>Agriopus</i> .....	139	<i>peruanus</i> .....	106
<i>Amblyopus</i> ( <i>Gobioides</i> ).....	134	<i>Polydactylus</i> .....	52
<i>Anthias</i> .....	79	<i>approximans</i> .....	52
( <i>Hemianthias</i> ).....	79	<i>polylepis</i> , <i>Balistes</i> .....	121
<i>Aplocheilus</i> .....	37	<i>Polynemus approximans</i> .....	52
<i>Archoscion</i> .....	96	<i>Pomacentrus latifrons</i> .....	12
<i>Astyanax</i> .....	27, 28, 117	<i>Pomadasis</i> .....	52
<i>Caranx</i> .....	62	<i>branicki</i> .....	5
<i>Centrolophus</i> .....	63	<i>burro</i> .....	5
<i>Cynoscion</i> .....	96	<i>leuciscus</i> .....	4
<i>Engraulis</i> .....	23	<i>macracanthus</i> .....	96
<i>Genyanemus</i> .....	108	<i>nitidus</i> .....	91
<i>Gobioides</i> .....	134, 135	<i>schyri</i> .....	55, 56
<i>Gyropleurodus</i> .....	2	<i>Pomodon macrophthalmus</i> .....	6
<i>Haplocheilus</i> .....	37	<i>Pontinus</i> .....	125
<i>Hemianthias</i> .....	79	<i>dubius</i> .....	125
<i>Lairus</i> .....	63	<i>furciferinus</i> .....	125
<i>Leptocephalus</i> .....	24	<i>strigatus</i> .....	125
<i>Lirus</i> .....	63	<i>Porichthys</i> .....	125
<i>Otolithus</i> .....	96	<i>afuerse</i> .....	125
<i>Polycirrhus</i> .....	108	<i>margaritatus</i> .....	125
<i>Polyclemus</i> .....	108	<i>porosus</i> .....	125
<i>Pronotogrammus</i> .....	79	<i>porosus</i> , <i>Porichthys</i> .....	125
<i>Stolephorus</i> .....	23	<i>Potamalosa</i> .....	11
<i>Tetragonopterus</i> .....	27	<i>notacanthoides</i> .....	11
<i>peruviana</i> , <i>Lepisoma</i> .....	145	<i>princeps</i> , <i>Caulolatilus</i> .....	110, 111
<i>peruvianus</i> , <i>Agriopus</i> .....	139	<i>Latilus</i> .....	11
<i>Clinus</i> .....	145	<i>Prionodes</i> .....	7
<i>Galeichthys</i> .....	31	<i>fasciatus</i> .....	7
<i>Gerres</i> .....	92	<i>huascaril</i> .....	7
<i>Tachisurus</i> .....	31	<i>Pristipoma branicki</i> .....	8
<i>Tetragonopterus</i> .....	28	<i>chalcum</i> .....	8
<i>petersii</i> , <i>Arbacia</i> .....	156	<i>conceptionis</i> .....	8
<i>philippi</i> , <i>Clinus</i> .....	144	( <i>Haemulopsis</i> ) <i>nitidum</i> .....	8
<i>philippi</i> , <i>Labrisomus</i> .....	144	<i>Pristipoma leuciscus</i> .....	8
<i>Lepisoma</i> .....	144, 145, 146	<i>var. elongatus</i> .....	8
<i>Philyptus</i> .....	133	<i>Pristipomus scapulare</i> .....	8
<i>lateralis</i> .....	133	<i>productus</i> , <i>Merluccius</i> .....	12
<i>maculatus</i> .....	123	<i>Pronotogrammus peruanus</i> .....	7

	Page.		Page.
Protistius.....	46	sanctasalemae, Decapterus.....	59
semotilus.....	46	sanguineus, Gobiesox.....	153
Psammobatis.....	16	Sicyases.....	153
brevicaudatus.....	16	Sarda.....	55
Pseudorhombus adspersus.....	140	chilensis.....	55
peltacinus, Serranus.....	77	Sardinella.....	20
Pteroplatea.....	16	fimbriata.....	20
orebripunctata.....	16	sagax.....	20
pulchra, Acara.....	116	stollifera.....	21
punctatus, Aplodactylus.....	115	sarattis, Abudedefduf.....	123
Epelytes.....	71	Chaetodon.....	123
Haplodactylus.....	115	Glyphisodon.....	123
punctulatum, Pygidium.....	35, 36	scabripinnis, Tetragonopterus.....	28
dispar.....	36	scapulare, Pristopomus.....	81
punctulatus, Trichomycterus.....	35	scapularis, Anisotremus.....	81
Pygidium.....	33	Scarostoma insignis.....	109
dispar.....	35	Scartichthys gigas.....	146
var. punctulatum.....	36	rubropunctatus.....	147
laticeps.....	35	schyri, Pomadasys.....	85, 86
oreyae.....	35	Sciaena.....	101
pardum.....	36	deliciosa.....	102
poeyanum.....	34	fasciata.....	101
punctulatum.....	35, 36	gilberti.....	103, 104, 105
quechuorum.....	36	minor.....	99
rivulatum.....	34	starksi.....	104, 105
taenia.....	35	wianeri.....	105
pyrrhocincla, Arbacloa.....	155, 156	Scomber.....	54
pyrrhocinclus, Arbacloa.....	155	colias.....	54
Sicyases.....	155	japonicus.....	54
quechuorum, Pygidium.....	34	Scomberomorus.....	55
quoyi, Gyropleurodus.....	3	sierra.....	55
Raja.....	13	seombrinus, Caranx.....	58
aguja.....	14	Decapterus.....	58, 59
burgeri.....	14	Decapturus.....	58
steindachneri.....	14	Scorpaena histrio.....	137
rammelsbergii, Mugil.....	50	pannosa.....	138
regia, Atherina.....	45	Scyllorhinus chilensis.....	3
regillus, Basilichthys.....	47, 48, 49	Scyllorhinus chilensis.....	3
reginae, Aplodactylus.....	115	Scyllium chilense.....	3
regius, Atherinopsis.....	45, 46, 48	Sebastes oculata.....	137
remora, Echenais.....	135	Sebastichthys.....	136
Remora.....	135	chamaco.....	136
retrosella, Amia.....	64	darwinii.....	137
Rhamdia.....	33	oculata.....	137
gilli.....	33	Sebastodes darwini.....	137
Rhina squatina.....	11	Selene.....	62
Rhinobatus.....	12	vomere.....	62
planiceps.....	12	semifasciatus, Serranus.....	73
Rhinoptera vespertilio.....	17	semispinosus, Trachurus.....	60
ringens, Engraulis.....	23, 24	semotilus, Protistius.....	46
rivulata, Acara.....	116	Seriola.....	58
Chromis.....	116	peruana.....	58
rivulatum, Pygidium.....	34	Serranus agassizii.....	72
rivulatus, Aequidens.....	116, 117	conceptionis.....	75
Trichomycterus.....	34	furcifer.....	78
rubropunctatus, Salarias.....	147	humeralis.....	73
Scartichthys.....	147	labriformis.....	69
rufipinnis, Exocoetus.....	44	peltacinus.....	77
sagax, Clupanodon.....	20	semifasciatus.....	78
Chupea.....	20	serrifer, Conodon.....	82
Sardinella.....	20	setipinnis, Vomer.....	62
Salarias.....	147	Zeus.....	62
Salarias gigas.....	146	Sicyases sanguineus.....	153
rubropunctatus.....	147	Sicyases pyrrhocinclus.....	155

	Page.		Page.
<i>sierra</i> , <i>Scomberomorus</i> .....	55	<i>Trachurus</i> .....	59
<i>simillimus</i> , <i>Gerres</i> .....	91	<i>boops</i> .....	61
<i>simonsi</i> , <i>Galeichthys</i> .....	31	<i>mediterraneus</i> .....	60
<i>Cycloptum</i> .....	37	<i>picturatus</i> .....	59
<i>sinaloa</i> , <i>Paralichthys</i> .....	140	<i>semispinosus</i> .....	60
<i>Siphostoma</i> .....	53	<i>symmetricus</i> .....	60
<i>aciculare</i> .....	53	<i>trachurus</i> .....	60
<i>blainvilliana</i> .....	53	<i>trachurus</i> , <i>Trachurus</i> .....	60
<i>soporator</i> , <i>Gobius</i> .....	134	<i>Trichomycterus barbatus</i> .....	34
<i>Mapo</i> .....	134	<i>dispar</i> .....	34
<i>Sparisoma cretense</i> .....	129	<i>gracilis</i> .....	34
<i>speculiger</i> , <i>Cypsilurus</i> .....	44	<i>inceae</i> .....	34
<i>Exocoetus</i> .....	44	<i>pentlandi</i> .....	34
<i>Spheroides</i> .....	132	<i>pictus</i> .....	34
<i>annulatus</i> .....	132	<i>poeyanus</i> .....	34
<i>Sphyræna</i> .....	51	<i>punctulatus</i> .....	35
<i>idiastes</i> .....	51	<i>rivulatus</i> .....	34
<i>Sphyrna</i> .....	53	<i>taenia</i> .....	35
<i>zygaena</i> .....	5	<i>Trochocopus darwini</i> .....	127
<i>Squalus squatina</i> .....	11	<i>tschudii</i> , <i>Discopyge</i> .....	16
<i>zygaena</i> .....	5	<i>Orestias</i> .....	40
<i>Squatina</i> .....	11	<i>Tylosurus</i> .....	43
<i>californica</i> .....	11	<i>stolzmanni</i> .....	43
<i>squatina</i> .....	11	<i>Umbrina analis</i> .....	106
<i>squatina</i> , <i>Rhina</i> .....	11	<i>panamensis</i> .....	106
<i>Squalus</i> .....	11	<i>xanti</i> .....	105
<i>Squatina</i> .....	11	<i>unifasciatus</i> , <i>Hemirhamphus</i> .....	43
<i>starksi</i> , <i>Sciaena</i> .....	104, 105	<i>Hyporhamphus</i> .....	43
<i>steindachneri</i> , <i>Raja</i> .....	14	<i>uniserialis</i> , <i>Ophichthus</i> .....	25, 26
<i>Stellifer</i> .....	99	<i>variegatus</i> , <i>Cheilodactylus</i> .....	113
<i>agassizii</i> .....	99	<i>variolosus</i> , <i>Lepisoma</i> .....	145
<i>ilicebrosus</i> .....	100	<i>venusta</i> , <i>Isaia</i> .....	89
<i>minor</i> .....	99	<i>vermiculatus</i> , <i>Aplodactylus</i> .....	115
<i>Stellifer minor</i> .....	99	<i>vespertilio</i> , <i>Holorhinus</i> .....	17
<i>Stolephorus</i> .....	22	<i>Rhinoptera</i> .....	17
<i>peruanus</i> .....	23	<i>volitans</i> , <i>Exocoetus</i> .....	44
<i>tapirulus</i> .....	23	<i>Vomer</i> .....	62
<i>stolifera</i> , <i>Clupea</i> .....	21	<i>gabonensis</i> .....	62
<i>Harengula</i> .....	21	<i>setipinnis</i> .....	62
<i>Sardinella</i> .....	21	<i>vomer</i> , <i>Selene</i> .....	62
<i>stolzmanni</i> , <i>Belone</i> .....	43	<i>Zeus</i> .....	62
<i>Cynoscion</i> .....	97	<i>wieneri</i> , <i>Gymnothorax</i> .....	26
<i>Otolithus</i> .....	97	<i>Lycodontis</i> .....	26
<i>Tylosurus</i> .....	43	<i>Sciaena</i> .....	105
<i>strigatus</i> , <i>Pontinus</i> .....	139	<i>woolmani</i> , <i>Paralichthys</i> .....	140
<i>Stromateus</i> .....	64	<i>xanti</i> , <i>Labrisomus</i> .....	143
<i>maculatus</i> .....	64	<i>Labrosomus</i> .....	143
<i>symmetricus</i> , <i>Caranx</i> .....	59	<i>Lepisoma</i> .....	143, 144, 147
<i>Trachurus</i> .....	59, 60	<i>Umbrina</i> .....	105
<i>Syngnathus acicularis</i> .....	53	<i>xenarcha</i> , <i>Mycteroperca</i> .....	70
<i>blainvillianus</i> .....	53	<i>xenarchus</i> , <i>Epinephelus</i> .....	70
<i>(Leptomotus) blainvillianus</i> .....	53	<i>Xenoscopus</i> .....	129
<i>Tachisurus peruvianus</i> .....	31	<i>denticulatus</i> .....	129
<i>Tachysurus</i> .....	32	<i>Xiphias</i> .....	56
<i>equatorialis</i> .....	32	<i>gladius</i> .....	56
<i>taenia</i> , <i>Pygidium</i> .....	35	<i>Xiphias gladius</i> .....	56
<i>Trichomycterus</i> .....	35	<i>Xystaema</i> .....	91
<i>tapirulus</i> , <i>Engraulis</i> .....	23	<i>cinereum</i> .....	91, 92
<i>Stolephorus</i> .....	23	<i>yuncensis</i> , <i>Pimelodella</i> .....	33
<i>taurina</i> , <i>Chrysophrys</i> .....	91	<i>Zeus setipinnis</i> .....	62
<i>taurinus</i> , <i>Calamus</i> .....	91	<i>vomer</i> .....	62
<i>Tetragonopterus microphthalmus</i> .....	28	<i>Zygaena malleus</i> .....	5
<i>peruanus</i> .....	27	<i>peruana</i> .....	5
<i>peruvianus</i> .....	28	<i>zygaena</i> , <i>Sphyrna</i> .....	5
<i>scabripinnis</i> .....	28	<i>Squalus</i> .....	5
<i>tetranemus</i> , <i>Blennius</i> .....	146	<i>zyopterus</i> , <i>Galeorhinus</i> .....	10
<i>Tetrodon annulatus</i> .....	132	<i>Galeus</i> .....	10
<i>Trachinotus paloma</i> .....	62		

SMITHSONIAN INSTITUTION  
UNITED STATES NATIONAL MUSEUM  
**Bulletin 96**

---

**A SYNOPSIS OF AMERICAN EARLY  
TERTIARY CHEILOSTOME BRYOZOA**

BY

FERDINAND CANU

*Of Versailles, France*

AND

RAY S. BASSLER

*Of Washington, District of Columbia*

PUBLISHED FEBRUARY 27, 1917



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1917

## ADVERTISEMENT.

The scientific publications of the United States National Museum consist of two series, the *Proceedings* and the *Bulletins*.

The *Proceedings*, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original, and usually brief, papers based on the collections of the National Museum, presenting newly acquired facts in zoology, geology, and anthropology, including descriptions of new forms of animals, and revisions of limited groups. One or two volumes are issued annually and distributed to libraries and scientific organizations. A limited number of copies of each paper, in pamphlet form, is distributed to specialists and others interested in the different subjects, as soon as printed. The date of publication is printed on each paper, and these dates are also recorded in the table of contents of the volumes.

The *Bulletins*, the first of which was issued in 1875, consist of a series of separate publications comprising chiefly monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, and catalogues of type-specimens, special collections, etc. The majority of the volumes are octavos, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable.

Since 1902 a series of octavo volumes containing papers relating to the botanical collections of the Museum, and known as the *Contributions from the National Herbarium*, has been published as bulletins.

The present work forms No. 96 of the *Bulletin* series.

RICHARD RATHBUN,

*Assistant Secretary, Smithsonian Institution,  
In charge of the United States National Museum.*

WASHINGTON, D. C., December 19, 1916.

# TABLE OF CONTENTS.

	Page.
Preface.....	5
Principles of classification.....	7
Systematic diagnoses.....	9
Suborder Anasca, division Malacostega.....	9
Family Electrinidae D'Orbigny.....	9
Membraniporae, new group.....	9
Family Aeteidae Smitt.....	22
Scrupocellariidae Levinsen.....	23
Farciminariidae Busk.....	23
Eucratiidae Hincks.....	24
Suborder Anasca, division Coilostega.....	25
Family Opsiulidae Jullien.....	25
Subfamily Onychocellidae Jullien.....	25
Microporidae Hincks.....	27
Lunulariidae Levinsen.....	30
Family Aspidostomidae Canu.....	30
Steganoporellidae Levinsen.....	31
Thalamoporellidae Levinsen.....	32
Suborder Anasca, division Pseudostega.....	32
Family Cellariidae Hincks.....	32
Coscinopleuridae Canu.....	33
Suborder Ascophora.....	34
The Costulae.....	34
Family Acroporidae Canu.....	37
Hippothoidae Levinsen.....	38
Escharellidae Levinsen.....	38
Group Schizoporellae.....	39
Hippoporinae.....	41
Peristomellae.....	43
Microporellae and divers genera.....	44
Family Stomachetosellidae, new.....	44
Smittinidae Levinsen.....	50
Reteporidae Smitt.....	55
Galeopsidae Jullien.....	56
Hippopodinidae Levinsen.....	60
Tubucellariidae Busk.....	62
Catenicellidae Busk.....	63
Adeonidae Jullien.....	64
Phylactellidae, new.....	66
Celleporidae Busk.....	71
Conescharellinidae Levinsen.....	73
Explanation of plates.....	77
Index.....	83



## PREFACE.

Since 1901 the junior author of this article has devoted much time to the accumulation of Tertiary bryozoa, particular attention being paid to material of this age from American localities. The object of these efforts lay in the hope that sooner or later an opportunity might be offered to monograph the subject. In the meantime the value of the bryozoa for purposes of stratigraphic correlation was recognized and this fact secured the active cooperation of several members of the United States Geological Survey, notably Dr. T. Wayland Vaughan. The collections resulting from these combined efforts proved so large and numerous that it soon became evident one person alone could not complete their study in a reasonable length of time. Besides the intimate relationship of the Tertiary bryozoa with the living forms required a good knowledge of the taxonomy and anatomy of the recent species on the part of the student who attempted the description of the fossil forms. Fortunately for the writer, Ferdinand Canu, of Versailles, France, well known for his extensive and accurate work on Mesozoic, Cenozoic, and Recent bryozoa, very kindly consented, in 1912, to join him in the study of the American Cenozoic faunas, with the result that now, after four years of work interrupted only by exigencies arising from the great war, a monograph of nearly five hundred species of Lower Tertiary Cheilostomata has been completed. As the publication of this monograph will of necessity be slow, it has been thought advisable to precede it with the following brief synopsis of the classification with description of the new genera and their genotypes.

R. S. BASSLER.



# A SYNOPSIS OF AMERICAN EARLY TERTIARY CHEILOSTOME BRYOZOA.

---

By FERDINAND CANU,  
*Of Versailles, France.*

AND

RAY S. BASSLER,  
*Of Washington, District of Columbia.*

---

## PRINCIPLES OF CLASSIFICATION.

The principles of classification of the cheilostome bryozoa are still imperfect in spite of the quite extended researches of several students. Formerly the classification was based on purely zoarial features, but in the latter half of the nineteenth century the zoecial characters were more closely studied, especially by D'Orbigny, Smitt, and Hincks. The latter author considered especially the form of the aperture; in other words, only the hydrostatic system. In 1888 and again in 1903 J. Jullien established a systematic set of characters for consideration. These are as follows in diminishing order of importance.

*Essential characters.*—(1) General morphology (order); (2) form of the frontal wall (suborder); (3) form of the aperture and of the operculum (family); (4) presence of cardelles, occurrence of lyrula and finally ovicells and radicles.

*Secondary characters (specific).*—Frontal punctations, avicularia, and vibracula.

In 1900 Canu wrote that every family ought to be based on an anatomical peculiarity, common to all its members and fixed in an uninterrupted series of descendance. He established the genera according to the variations of this anatomical peculiarity and according to the divergence in its evolutionary characters. This was a perfection of Jullien's ideas, but the partial application made by Waters to the opercula and the avicularian mandibles did not appear always to lead to uniform results or to the establishment of very natural genera.

We believe that other principles are better. In the bryozoa as in other living beings the form is only the result of a function;

therefore in the study of the morphological variations of the organs we now substitute that of their physiologic functions. Our studies are therefore always directed toward the discovery of functions which modify the skeletal form.

*Family*.—All the species which have the same larval form have the same lineage and belong necessarily to the same family; therefore the family is characterized by the larval system. The ovicell in which the larva develops is necessarily in rapport with it, and a knowledge of its structure gives the essential characters for readily interpreting the physiological purpose of the morphological and skeletal variations.

*Genus*.—A really natural genus differs from another genus only in possessing a different function and in the different form of any skeletal part. The essential functions common to all bryozoa without exception are:

1. Passage of eggs and escape of the larvae (=rapport of the operculum and the ovicell).
2. Hydrostatic system and extrusion of the polypide (=form of the aperture and rapport of the operculum with the compensatrix).
3. Calcification and chitinization (=nature of the skeleton and of the frontal considered as immediate deposits of the endocyst).

We have rigorously followed this principle in the establishment of our new genera and we have also modified the diagnoses of the described natural genera which were often incomplete.

The function of the avicularia and of the onychocellaria is not known but it can not be common to all bryozoa because many species are deprived of these structures; these structures therefore can not furnish good generic characters. Nevertheless there are some groups in which their presence appears to be absolutely indispensable to the life of the zoarium and we have therefore considered them sometimes in our generic diagnoses.

The general classification of the Bryozoa showing the larger subdivisions of the Cheilostomata is printed below for convenience of reference.

<i>Class.</i>	<i>Subclass.</i>	<i>Order.</i>	<i>Suborder.</i>	<i>Division.</i>
Bryozoa.	Gymnolaemata.	Ctenostomata.		
		Cyclostomata.		
		Trepostomata.		
		Cryptostomata.		
	Phylactolaemata.	Chellostomata	<div> Anasca.  Ascophora. </div>	<div> Malacostega.  Collostega.  Pseudostega. </div>

## SYSTEMATIC DIAGNOSES.

## Order CHEILOSTOMATA Busk.

## Suborder ANASCA Levinsen.

A zoecial hydrostatic system is absent but a zoarial hydrostatic system is present and is included between the cryptocyst and the ectocyst.

The *Anasca* are classified under the three divisions *Malacostega*, *Coilostega*, and *Pseudostega*.

## Division I. MALACOSTEGA Levinsen.

The parietal muscles are attached to the cryptocyst, which is always chitinous. The operculum is a membranous valve. In the fossil forms the frontal wall is quite or partially calcified.

The families of this division represented in the American Eocene are as follows:

*Electrinidae* D'Orbigny, 1851.

*Membraniporae*, new group.

*Aeteidae* Smitt, 1867.

*Scrupocellariidae* Levinsen, 1909.

*Farciminariidae* Busk, 1884.

*Eucratiidae* Hincks, 1880.

## Family ELECTRINIDAE D'Orbigny, 1851.

Zoecia having a chitinous frontal. Intertentacular organ present. Larva a cyphonautes. No avicularia. No dietellae. Operculum with thickened border.

The known genera of the *Electrinidae* are as follows:

*Electra* Lamouroux, 1816. Eocene–Recent.

*Membranipora* Blainville, 1834. Recent.

*Heterooecium* Hincks, 1892. Recent.

*Pyripora* D'Orbigny, 1852. Cretaceous–Recent.

*Herpetopora* Lang, 1914. Cretaceous–Vicksburgian.

The two latter genera have been placed in the family on account of zoecial resemblance and not from a study of their anatomy. Both of these genera are represented in the Eocene of the United States.

**MEMBRANIPORAE, new group.**

This very large group is too heterogenous to be considered as a single family; indeed it is certain that the genera classified here at present will ultimately be assigned to many families. Unfortunately we are ignorant of the larvae and researches upon the anatomy of these forms have not been made.

The material upon which our present researches are founded is most abundant; but as it is impossible to establish a satisfactory

nomenclature with fossils alone we must be content to utilize the works of our predecessors. We have studied especially the ovicells and their relations to the opercular valve, for these are the organs in closest relation to the larval system. In the following table are listed the genera of *Membraniporae* with the possible family reference of some of them.

#### SECTION I.—NO OVICELL.

*Conopeum* Norman, 1903. Cenomanian-Recent.

*Membraniporina* Levinsen, 1909.

*Odontionella*, new genus. Lutecian-Recent.

*Adenifera*, new genus. Jacksonian-Recent.

*Trochopora* D'Orbigny. Lutecian-Helvetian.

*Otionella*, new genus. Campanian-Jacksonian.

#### SECTION II. OVICELL ENDOZOCEAL.

*Vibracellina*, new genus. Claibornian-----Lunulariidae.

*Hincksina* Norman, 1903. Jacksonian-Recent. Flustridae (Norman).

*Ogivalina*, new genus. Jacksonian-----Onychocellidae.

*Membrendoecium*, new genus. Eocene-Recent-----Farmiciniariidae.

#### SECTION III. OVICELL HYPERSTOMIAL, CLOSED BY THE OPERCULAR VALVE.

*Periporosella*, new genus. Jacksonian.

*Ellisina* Norman, 1913. Senonian-Recent.

*Grammella* Canu, 1916. Santonian-Recent.

*Membraniporidra*, new genus. Jacksonian-Vicksburgian.

*Tremopora* Ortman, 1890. Helvetian-Recent.

*Larnacius* Norman, 1903. Recent.

#### SECTION IV. OVICELL HYPERSTOMIAL, NOT CLOSED BY THE OPERCULAR VALVE.

*Alderina* Norman, 1903. Senonian-Recent.

*Callopora* Gray, 1848. Santonian-Recent.

*Amphiblestrum* Gray, 1848. Senonian-Recent.

*Ramphonotus* Norman, 1894. Senonian-Recent.

*Tegella* Levinsen, 1909. Santonian-Recent.

*Stamenocella*, new genus. Senonian-Vicksburgian---Bicellariidae.

#### SECTION I. MEMBRANIPORAE WITHOUT OVICELL.

Genus *CONOPEUM* Norman, 1903.

1903. *Conopeum* NORMAN, Natural History of East Finmark, *Annals Magazine Natural History* (7), vol. 11, p. 586 (1848. Gray, List British Animals British Museum, *Centroniae*, pp. 108, 146).

No ovicell, no dietellae, no avicularia. The margins of the mural rim are wholly granulated. A distal, multiporous septula; 2 or 3

lateral septulae. Triangular, interopesia hollows having peculiar walls.

*Genotype*.—*Membranipora lacroixii* Authors. Range: Cenomanian–Recent.

The American Eocene species are *Conopeum lacroixii* Busk, 1852, from the Claibornian and Lower Jacksonian of Mississippi, *C. hookeri* Haime, occurring in the Lower Jacksonian of Mississippi and seven new species ranging from the Midwayan to the Jacksonian.

### Genus MEMBRANIPORINA Levinson, 1909.

1909. *Membraniporina* LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 145.

Membranipores exhibiting neither ovicells nor avicularia.

*Membraniporina* is not a true genus but is simply an artificial grouping proposed by Levinson for the reception of species incompletely described or of which we have insufficient information to place them more definitely.

The American species of *Membraniporina* are *Membraniporina rimulata* Ulrich, 1901, from the Aquia formation of Maryland, *M. laxa* Reuss, 1869, from the Claibornian of Alabama, and five new species from the Midwayan, Jacksonian, and Vicksburgian of the Southern States. The following new species is interesting because of the peculiar, calcified tubule in the zoecium.

### MEMBRANIPORINA BENJAMINI, new species.

Plate 1, fig. 1.

*Description*.—The zoarium is incrusting. The zoecia are large, elongate, elliptical, and distinct; the mural rim is rounded, smooth everywhere of equal width. The opesia is median, elliptical, entire. In the vicinity of the septulae there is often an incomplete small canal.

*Measurements*.<sup>1</sup>—Opesia  $\left\{ \begin{array}{l} ho=0.57 \text{ mm.} \\ lo=0.30 \text{ mm.} \end{array} \right.$   
Zoecia  $\left\{ \begin{array}{l} Lz=0.65-0.70 \text{ mm.} \\ lz=0.40-0.45 \text{ mm.} \end{array} \right.$

*Affinities*.—Only the fragment figured, which is of considerable interest, has been found. In the proximal part of the zoecium in front of each septula, there is a sort of incompletely calcified tubule serving probably to protect the mesenchyme filaments which pass from one zoecium to another.

<sup>1</sup> In the citation of measurements, *ho* is the length and *lo* the width of the opesia, *Lz* and *lz* similarly the length and width of the zoecia, *Lv* and *lv* the same for the vibraculum, *Lon* and *lon* for the onychocellaria, *ha* and *la* for the apertura, etc.

This interesting species is named after Dr. Marcus Benjamin, editor of the United States National Museum.

*Occurrence*.—Upper Jacksonian: Rich Hill, 5½ miles southeast of Knoxville, Crawford County, Georgia (very rare).

*Type*.—Cat. No. 62596, U.S.N.M.

#### ODONTIONELLA, new genus.

(*Odontion*, denticle.)

No intertentacular organ. No dietellae. With denticular plate in the opesia. Septulæ fairly numerous. Zoarium may be unilaminate or bilaminate in the same species. (After Waters.)

*Genotype*.—*Membranipora hians* Hincks, 1885. Range.—Lutecian-Recent.

We have instituted this genus for the *hians* group (No. 13) of Waters which this author thought in 1898 should be removed from *Membranipora*.

*Odontionella* (*Membranipora*) *savartii* Audouin, 1826, the widely distributed Tertiary and recent form occurs in the Upper Jacksonian and Vicksburgian of Mississippi and Alabama.

#### ADENIFERA, new genus.

(*Aden*, gland.)

With a distal glandular penthouse.

*Genotype*.—*Membranipora armata* Haswell, 1880. Range.—Jacksonian-Recent.

#### ADENIFERA INARMATA, new species.

Plate 1, fig. 2.

*Description*.—The zoarium is unilamellar, living upon algae; its lower side bears hydrostatic tuberosities. The zoæcia are very large, ogival in form, and distinct; the mural rim is very finely granulated, rounded, enlarged at the base where it sometimes bears callosities. The opesium is entire, elliptical but somewhat irregular. On the distal part of the mural rim there is an arched pad which is hollow, fragile, and symmetrical, the forepart containing two glands. No avicularia.

*Measurements*.—Opesia  $\left\{ \begin{array}{l} ho=0.60-0.66 \text{ mm.} \\ lo=0.50 \text{ mm.} \end{array} \right.$

Zoæcia  $\left\{ \begin{array}{l} Lz=0.80-0.90 \text{ mm.} \\ lz=0.60-0.70 \text{ mm.} \end{array} \right.$

*Affinities*.—This species differs from *Adenifera* (*Membranipora*) *striata* MacGillivray, 1904, from the Miocene of Australia, in its much smaller micrometric measurements and in the reduction of its cryp-

tocyst. It differs from the recent *A. armata* Haswell, 1880, in the total absence of a lateral avicularium on the distal arch.

*Occurrence*.—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common).

Wilmington, North Carolina (very rare).

*Type*.—Cat. No. 62570, U.S.N.M.

#### Genus TROCHOPORA D'Orbigny, 1851.

1851. *Trochopora* D'ORRIGNY, Paleontologie française, Terrain Cretace, Bryozoaires, vol. 5, p. 506.

The zoarium has the Lunulites form. The zoecia and the vibracula are arranged in distinct rows. The ancestrular zoecia are either hydrostatic or radicular. The growth of the zoarium is effected by superimposed (unizocæial) disks with the zoecia arranged in single rows. No ovicell. The vibracula are symmetrical.

*Genotype*.—*Trochopora conica* Defrance, 1883.

*Range*.—Lutecian-Helvetian.

*Trochopora* (*Lunulites*) *bouei* Lea, 1833, of the Claibornian and Lower Jacksonian of the Southern States and *Trochopora* (*Lunulites*) *truncata* De Gregorio, 1890, from the same horizons are two abundant species of this genus in America.

#### OTIONELLA, new genus.

(*Otion*, a little ear, in allusion to the form of the vibraculum.)

The zoarium is discoidal (*Lunulites* form), with neither ovicell nor radicular and hydrostatic zoecia. The vibraculum is interzoecial, unsymmetrical, auriculated, one lip more prominent than the other. The zoecia are hexagonal and disposed in quincunx on the outer face and in radial lines on the inner side. The ancestrula is as large as the other zoecia and of the same form.

*Genotype*.—*Otionella perforata*, new species.

*Range*.—Campanian-Jacksonian.

Besides the genotype described below, three other new species of the genus are known in the Claibornian and Jacksonian.

#### OTIONELLA PERFORATA, new species.

Plate 1, figs. 3, 4.

*Description*.—The zoarium is discoidal with a concave inner face. The zoecia are ogival in shape, broad, distinct, separated by a furrow, disposed in very irregular radial and transverse lines; the mural rim is broad on the sides and below with a projecting summit; the opesium is elliptical, little elongated, nearly orbicular, bordered by a projecting collar. The vibraculum is as large as the zoecium, unsymmetrical and auriculated, rather narrow. On the inner face the radial ribs are perforated with numerous pores. There are at

least two pairs of large lateral septulæ to each zoecium and only one pair in the vibraculum.

*Measurements.*—Opesium  $\begin{cases} ho=0.12 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{cases}$

Zoecium  $\begin{cases} Lz=0.25 \text{ mm.} \\ lz=0.20-0.27 \text{ mm.} \end{cases}$

Vibraculum  $\begin{cases} Lv=0.25 \text{ mm.} \\ lv=0.10 \text{ mm.} \end{cases}$

*Occurrence.*—Claibornian: Claiborne, Alabama (common).

Lower Jacksonian: Jackson, Mississippi (common).

*Type.*—Cat. No. 62571, U.S.N.M.

## SECTION II. MEMBRANIPORÆ WITH ENDOZOECIAL OVICELL.

We have recognized four genera of Membranipores provided with an endozoecial ovicell, a structure which distinguishes them from genera of the first section quite as clearly as from those which have a hyperstomial ovicell. Furthermore, these four genera do not appear to belong even to the same family.

*Vibracellina* may perhaps belong to the Lunulariidae.

*Hincksina*, according to Norman, is a member of the Flustridae.

*Ogivalina* is possibly a member of the Onychocellidae.

*Membrendoecium* may perhaps be referred to the Farciminariidae.

In the present state of bryozoology, generic grouping in distinct families quite frequently is necessarily artificial, arbitrary, and problematic since we lack anatomical and larval data in many cases. It is better therefore to maintain these four genera in the present place rather than to introduce them doubtfully into the recent families mentioned above.

### VIBRACELLINA, new genus.

Endozoecial ovicell. Auriform vibracula. No cryptocyst. No dietellae.

*Genotype.*—*Vibracellina capillaria*, new species. Claibornian.

### VIBRACELLINA CAPILLARIA, new species.

Plate 1, fig. 5.

*Description.*—The zoarium incrusts small shells. The zoecia are elongate, distinct, oval, with a very small gymnocyst; the mural rim is convex, salient, very thin, almost capillary. The opesium is oval, entire. The vibraculum is interzoecial, unsymmetrical; its opesium is oblique and bounded by two lips of which the upper one is convex and sinuous. The ovicell is a distal convexity.

*Affinities.*—At the center of the figured zoarium may be noted two smaller zoecia almost equal; which of these is the ancestrula can not be discerned. It is also to be noted that excepting these, the

zoecia assume their normal size almost immediately. The absence of gymnocyst and cryptocyst will distinguish this species easily from *Pyripora confluens* Canu, 1907 (not Reuss).

*Occurrence*.—Claibornian (Lisbon beds); Moseley's Ferry, Caldwell County, Texas (rare).

*Type*.—Cat. No. 62572, U.S.N.M.

#### Genus *HINCKSINA* Norman, 1903.

1903. *Hincksina* NORMAN, Natural History of East Finmark, Annals and Magazine Natural History, (7) vol. 11, p. 585.

Zoecia incrusting, having the entire area membranous, the margin surmounted by numerous spines. Ovicell small, short, and little raised. Avicularia occupying distinct cells sparingly scattered among the zoecia, oval, with semicircular mandible. No dietellae. (Norman.)

*Genotype*.—*Membranipora flustroides* Hincks, 1880.

*Range*.—Jacksonian—Recent.

The American Early Tertiary species of *Hincksina* may be divided into two sections, a new species of each of which is described below.

#### SECTION I. AVICULARIA LITTLE DIFFERENTIATED.

##### *HINCKSINA JACKSONICA*, new species.

Plate 1, fig. 6.

*Description*.—The zoarium is free, bilamellar, easily divisible into two layers. The zoecia are elongated, distinct, elliptical, often with a small gymnocyst; the mural rim is convex, enlarged at the base, finely granulated. The opesium is terminal, elliptical, regular, very finely denticulated. The ovicell is endozoecial and little apparent; it appears as a small distal convexity. Avicularian zoecia are very rare.

*Measurements*.—Opesia  $\left\{ \begin{array}{l} \text{ho} = 0.35-0.45 \text{ mm.} \\ \text{lo} = 0.20-0.25 \text{ mm.} \\ \text{Lz} = 0.45-0.65 \text{ mm.} \end{array} \right.$   
Zoecia  $\text{lz} = 0.35-0.40 \text{ mm.}$

The two lamellae forming the zoarium separate very easily, each preserving its own base.

*Variations*.—The zoecial length is quite variable; both long and short zoecia may occur. The avicularian zoecia or interzoecial avicularia are rather rare. They are generally primoserial; their opesium presents a lateral constriction but little accentuated.

This species is distinguished from the other species of *Hincksina* by the absence of visible spines and by its free zoarium. It is rather common at many localities of the Jacksonian, of which it appears to be a characteristic fossil.

*Occurrence*.—Middle Jacksonian: Rich Hill, 5½ miles southeast of Knoxville, Crawford County, Georgia (abundant), and many other localities.

*Type*.—Cat. No. 62573, U.S.N.M.

## SECTION II. INTERZOEAL AVICULARIA DIFFERENTIATED.

### HINCKSINA MEGAVICULARIA, new species.

Plate 1, fig. 7.

*Description*.—The zoarium incrusts other bryozoa. The zoecia are large, distinct, elongated, pyriform, and have a gymnocyst; the mural rim is convex, salient, provided with 14 to 20 large hollow spines. The opesium is terminal, elliptical, or somewhat pyriform, entire; the interzoecial avicularium is large, symmetrical, and has a gymnocyst; its opesium is constricted laterally, probably at the place where the pivot ought to be.

*Measurements*.—Opesia  $\left\{ \begin{array}{l} ho = 0.30-0.35 \text{ mm.} \\ lo = 0.25 \text{ mm.} \end{array} \right.$

Zoecia  $\left\{ \begin{array}{l} Lz = 0.60-0.70 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{array} \right.$

Length of avicularia = 0.60–0.65 mm.

*Affinities*.—On account of its large avicularia this species approaches the recent *Hincksina pyrula* Hincks, 1881. It differs, nevertheless, in its larger number of spines; unfortunately we are unable to compare the ovicells.

The specimen figured is very instructive. On a zoecium can be seen the coalescing of opposite spines giving an aspect like the frontal of *Membraniporella*. In other examples many zoecia are regenerated; in one case a normal zoecium succeeds a normal zoecium and a double row of spines results; in another case an avicularium replaces a zoecium, but in a totally inverted position.

*Occurrence*.—Middle Jacksonian (Castle Hayne limestone); Wilmington, North Carolina (very rare).

*Type*.—Cat. No. 62574, U.S.N.M.

### OGIVALINA, new genus.

Endozoecial ovicell. Granular cryptocyst. No dietellae. No spines.

*Genotype*.—*Ogivalina eximipora*, new species.

The zoecia have the usual aspect of those in the family *Onychocellidae*, but the interzoecial onychocellarium is replaced by an interopesial avicularium.

In addition to the genotype this genus is represented by a new species and a new variety from the Middle Jacksonian of North and South Carolina.

## OGIVALINA EXIMIPORA, new species.

Plate 2, fig. 1.

*Description.*—The zoarium is composed of one or more lamellae and incrusts pebbles or creeps over algae. The zoecia are large, elongated, ogival, distinct, separated by a threadlike ridge; the mural rim is indistinct, thin, flat, smooth, enlarged at the base into a concave, granular, irregular cryptocyst. The opesium is oval, entire, unsymmetrical in its proximal part. The endozoecial ovicell is a distal convexity, quite apparent. The avicularium is interopesial, triangular, relatively small, and without pivot.

*Measurements.*—Opesia  $\left\{ \begin{array}{l} ho=0.75-0.80 \text{ mm.} \\ lo=0.55-0.70 \text{ mm.} \end{array} \right.$   
 Zoecia  $\left\{ \begin{array}{l} Lz=1.20-1.25 \text{ mm.} \\ lz=0.80 \text{ mm.} \end{array} \right.$

Length of avicularium=0.40 mm.

*Variations.*—The opesium has little regularity of shape on account of the very irregular development of the cryptocyst itself. Although the latter is generally plainly visible, there are, nevertheless, zoecia which are almost devoid of the cryptocyst. But the most important variation is the unsymmetrical shape of its distal border, a lack of symmetry characteristic of the genus *Onychocella*. We know that this phenomenon is occasioned by the obliquity of the polypide in the zoecium by reason of the attachment of the retractor muscles in one of the proximal corners of the said zoecium. This anatomical feature appears to have more importance than the absence of the onychocellarium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare).

Near Lenuds Ferry, South Carolina (very rare).

Rich Hill, Crawford County, Georgia (very rare).

*Type.*—Cat. No. 62575, U.S.N.M.

## MEMBRENDOECIUM, new genus.

(Abbreviation of Membranipore with endozoecial ovicell.)

Ovicell endozoecial. Small simple interopesial avicularia. Diastellae present. No spines.

*Genotype.*—*Amphiblestrum papillatum* Busk, 1884.

## MEMBRENDOECIUM PYRIFORME, new species.

Plate 2, fig. 2.

The zoarium incrusts bryozoa or small shells. The zoecia are very elongate, oval, distinct, and have a gymnocyst; the mural rim is

prominent, smooth, somewhat convex, enlarged on the margins, and much enlarged at the base. The opesium is oval, entire. The ovicell is endozoöcial and is a small, smooth, distal convexity. The avicularia are very small, straight, salient, elliptical, often provided with a gymnocyst. The ancestrula is surrounded by closed zoöcia in which the frontal is perforated by an orbicular pore.

*Measurements.*—Opesia  $\begin{cases} ho=0.20-0.30 \text{ mm.} \\ lo=0.13-0.16 \text{ mm.} \end{cases}$   
 Zoöcia  $\begin{cases} Lz=0.40-0.50 \text{ mm (omitting the gymnocyst).} \\ lz=0.24-0.30 \text{ mm.} \end{cases}$

*Variations and affinities.*—The length of the gymnocyst is quite variable even on the same zoarium; therefore in the micrometric measurements it is preferable not to count the gymnocyst for many of the zoöcia are devoid of it. The reduction of the zoöcial length is frequent in this species and affects the entire zoarium; it is rather a rare occurrence when some mechanical obstacle is not opposed to the free development of the zoöcia.

*Occurrence.*—Vicksburgian:  $7\frac{1}{2}$  miles southwest from Bladen Springs, Alabama (very rare).

Middle Jacksonian: Lenuds Ferry, South Carolina (rare).

Lower Jacksonian: Jackson, Mississippi (very rare).

*Type.*—Cat. No. 62576, U.S.N.M.

### SECTION III. OVICELL HYPERSTOMIAL, ALWAYS CLOSED BY THE OPERCULUM.

It is not easy to recognize on a fossil form whether the opercular valve does or does not close the hyperstomial ovicell. After many dissections which we have made on living species we have recognized that ovicells of this kind generally leave a concave cicatrix above the mural rim, a part of which is thus concealed. We would add that the different genera grouped in this section, although very natural in themselves, appear to belong to different families which the zoologists alone can determine.

#### PERIPOROSELLA, new genus.

(*Peri*, around; *poros*, pores.)

Each zoöcium is surrounded by a special series of dietellae (12-16) communicating with two large septulae.

*Genotype.*—*Periporosella tantilla*, new species. Jacksonian.

In all the other genera of Membranipores provided with dietellae, the latter occupy only the anterior half of the zoöcium. In the genus *Periporosella* they are, on the contrary, arranged all about the

zoecium, as in the family Adeonidae. These dietellae are invisible externally, and they become apparent only in tangential sections of some depth.

**PERIPOROSILLA TANTILLA, new species.**

Plate 2, figs. 3. 4.

The zoarium is free, formed by two lamellae joined together and inseparable. The zoecia are generally indistinct, very elongated, rectangular; the mural rim is broad, flat, enlarged at the base. The opesium is elliptical, somewhat enlarged distally, and very finely denticulated. The ovicell deep, but placed above the large distal septula; it projects but little exteriorly. The avicularia are interzoecial, rare, elliptical, without pivot, but with two lateral denticles; numerous dietellae in each zoecium.

This type of structure is different from all others on account of its dietellae, its method of gemmation, its ovicell, and even its avicularia. It certainly belongs to a family which our present zoological knowledge will not yet permit us to suspect.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common). Near Lenuds Ferry, South Carolina (rare).

Eutaw Springs, South Carolina (rare).

*Type.*—Cat. No. 62577, U.S.N.M.

**Genus ELLISINA Norman, 1903.**

1903. *Ellisina* NORMAN, Natural History of East Finmark, Annals and Magazine Natural History (7), vol. 11, p. 596.

The zoecia are furnished with avicularia, ovoid or triangular, situated on the hinder portion of the zoecium. The ovicell is well developed, typically with a flattened area on its front. In the type-species the pore-chambers (dietellae) are very large; one distal; the position of the remaining chambers is very unusual, the two front lateral pairs project outside the side walls, which is the reverse of the usual rule.

*Genotype.*—*Membranipora laxata* Hincks, 1882. (Norman.)  
Range.—Senonian-Recent.

**ELLISINA LAXA, new species.**

Plate 2, fig. 7.

*Description.*—The zoarium incrusts pebbles and especially shells. The zoecia are large, distinct, broad, ogival; the mural rim is very thin, little salient, curved, finely striated. The opesium is very large and of the same form as the zoecium. The avicularium is triangular, interzoecial, transverse, and without pivot.

*Measurements.*—Zoecia  $\left\{ \begin{array}{l} Lz=0.75-0.95 \text{ mm.} \\ lz=0.50-0.75 \text{ mm.} \end{array} \right.$

*Affinities*.—The dietellae open into the zoecia in large pores which are really the remains of multiporous septulae. The ovicell is rare and very small.

The species differs from *Ellisina* (*Semiflustrella*) *rhomboidalis* D'Orbigny in its dimensions twice as large and in the ogival and nonrhomboidal form of the zoecia. It is the largest known species of *Ellisina*.

*Occurrence*.—Middle Jacksonian: Wilmington, North Carolina (very rare).

Upper Jacksonian (Ocala limestone):  $1\frac{1}{2}$  miles above Bainbridge, Georgia (rare).

Vicksburgian: Salt Mountain, 5 miles south of Jackson, Alabama (very rare).

*Type*.—Cat. No. 62580, U.S.N.M.

#### GRAMMELLA Canu, 1916.

1916. *Grammella* CANU, Bulletin Société Géologique de France (4), vol. 16.

The operculum closes the ovicell. The avicularium is interzoecial, large, with a solid pivot; its form recalls that of the Greek letter  $\theta$ . No dietellae.

*Genotype*.—*Membranipora crassimarginata* Hincks, 1880.

*Range*.—Santonian-Recent.

#### GRAMMELLA TRANSVERSA, new species.

Plate 2, fig. 6.

*Description*.—The zoarium incrusts bryozoa. The zoecia are but little elongated, broad, distinct; the mural rim is thin, sharp edged, regular. The opesium is of the same form as the zoecium. The ovicell is salient, globular, smooth, and carinated. The avicularium is interzoecial, small, elliptical, and the pivot is never median; its longitudinal axis is transverse with respect to the zoecial axis.

*Measurements*.—Opesia  $\begin{cases} ho=0.45 \text{ mm.} \\ lo=0.35-0.40 \text{ mm.} \end{cases}$

Zoecia  $\begin{cases} Lz=0.55-0.60 \text{ mm.} \\ lz=0.46-0.50 \text{ mm.} \end{cases}$

*Affinities*.—The avicularium is generally elliptical but it is sometimes triangular. The mural rim exhibits a rare and interesting peculiarity. It is not provided with a side which merges into the zoecium so that the opesium is bounded by the termen itself of the mural rim. The present form differs from other described species of *Grammella* in its small avicularia transversely oriented.

*Occurrence*.—Middle Jacksonian: Wilmington, North Carolina (very rare).

*Type*.—Cat. No. 62579, U.S.N.M.

**MEMBRANIPORIDRA, new genus.**

The operculum always closes the ovicell. No dietellae. No avicularia. One large distal septula; two pairs of lateral septulae.

*Genotype*.—*Membraniporidra porrecta*, new species.

The ovicell is deeply excavated in the distal zoecium. It is only by dissection that we are able to prove by the continuity of the mural rim, although very thin distally, that the ovicell is indeed hyperstomial. The mural rim is always enlarged at the base and finely granular.

This genus differs from *Alderina* Norman, 1903 not only in the closure of the ovicell by the opercular valve but also in the absence of dietellae.

**MEMBRANIPORIDRA PORRECTA, new species.**

Plate 2, fig. 5.

The zoarium is free, follicular, formed of two very thin leaves, growing back to back and easily separable. The zoecia are large, elongate, distinct, oval, with a proximal, convex gymnocyst; the mural rim is very thin, salient, curved. The opesium is large, elliptical, entire. The ovicell is globular, little elevated, ornamented with a frontal callosity; it is deeply embedded. A distal septula and two lateral septulae and two distal impressions are present.

*Measurements*.—Opesia  $\left\{ \begin{array}{l} \text{ho} = 0.75 \text{ mm.} \\ \text{lo} = 0.30 \text{ mm.} \end{array} \right.$  Zoecia  $\left\{ \begin{array}{l} \text{Lz} = 0.95 \text{ mm.} \\ \text{lz} = 0.38 \text{ mm.} \end{array} \right.$

*Occurrence*.—Middle Jacksonian: Wilmington, North Carolina (common).

Baldock, Barnwell County, South Carolina (rare).

*Type*.—Cat. No. 62578, U.S.N.M.

**SECTION IV. OVICELL NEVER CLOSED BY OPERCULAR VALVE.**

The ovicell is widely open above the operculum and the opesium. In the fossil forms the distal part of the mural rim is visible and not modified; the distal cicatrix left by the broken ovicell on the superior zoecium is shallow. In the recent species this kind of ovicell is closed by a vesicle which retracts or dilates by means of special muscles to facilitate the departure of the larvae or the entrance of the eggs.

*Alderina* Norman, 1903, *Callopora* Gray, 1848, *Amphiblestrum* Gray, 1848, *Ramphonotus* Norman, 1894, and *Tegella* Levensen, 1909, belong to this division of the Membranipores and are well represented in the Early Tertiary strata of North America.

**STAMENOCELLA, new genus.**

(*Stamen*, in allusion to the form of the zoecium.)

Ovicell hyperstomial, not closed by the opercular valve. No dietellae. Gymnocyst long and flat, supporting a small, sessile, salient avicularium.

*Genotype*.—*Stamenocella mediaviculifera*, new species.

*Range*.—Senonian-Vicksburgian.

The genus which is nearest to this type of structure is *Bactrellaria* Marsson, 1887, in which the zoœcia are identical, but are disposed on a single side of a triserial zoarium. The two genera undoubtedly belong to the same family.

**STAMENOCELLA MEDIAVICULIFERA, new species.**

Plate 3, fig. 1.

*Description*.—The zoarium is bilamellar, with the two lamellae back to back and inseparable. The zoœcia are very elongated, narrowed behind, distinct or indistinct; the mural rim is thin, salient, somewhat enlarged and attenuated, rounded, smooth. The opesium is elliptical or oval, entire; the gymnocyst is somewhat convex and nearly as long as the opesium. The avicularium is salient and placed in the middle of the gymnocyst. The ovicell is rarely intact.

*Measurements*.—Opesia  $\left\{ \begin{array}{l} ho=0.40 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{array} \right.$

Zoœcia  $\left\{ \begin{array}{l} Lz=0.80 \text{ mm.} \\ lz=0.20-0.24 \text{ mm.} \end{array} \right.$

*Variations and affinities*.—This species apparently lived in agitated waters. Although widely distributed, it is often very rare, and specimens are always more or less worn. In this condition the mural rim is worn away and invisible, the zoœcia indistinct, and the avicularia absent or replaced by a concave cicatrix. We have never found the ovicell intact; it is always more or less broken but its place is clearly visible on the gymnocyst. The avicularium is of the simple type without denticles or pivot.

*Occurrence*.—Middle Jacksonian: Rich Hill, Crawford County, and other localities in Georgia (very common).

*Type*.—Cat. No. 62581, U.S.N.M.

**Family AETEIDAE Smitt, 1867.**

Zoarium composed of creeping branches more or less adherent to the substratum, often growing in free tufts adherent only part of their length. Zoœcia uniserial, arising from each other in a tubular prolongation of greater or less length. Opesium terminal, opercular valve at its summit. (After Robertson.)

**Genus AETEA Lamouroux, 1812.**

The American Eocene deposits contain two species of this genus which for lack of well-preserved specimens can only be referred to the well-known recent species *Aetea anguina* Linnaeus, 1758 and *A. truncata* Landsborough, 1852.

## Family SCRUPOCELLARIIDAE Levinsen, 1909.

The zoecia have large opesia. A gymnocyst and a cryptocyst more or less developed. The mural rim bears distally one or two pairs of spines and laterally a membraneous scutum. The distal wall, consisting of a horizontal basal and an obliquely ascending frontal part, has usually numerous, small, scattered, uniporous septulae basally, while the distal half of each lateral wall has one multiporous septula. Besides dependent avicularia, found in most species, vibracula may also occur on the basal surface of the zoarium, and these are connected with the zoarium by an independent wall. The ovicells are generally hyperstomial. As a rule, radicular fibers occur, sometimes springing from a septula (or a dietella), sometimes from a separate chamber connected with a vibraculum. The zoaria are always free, much branched, most frequently with uni- or few series zoecia, generally consisting of a single layer and in most cases jointed by means of chitinous transverse belts. (After Levinsen, 1909.)

American Tertiary specimens are rare, small, and very fragile, and as a result we have been unable to make any detailed studies of the family. The principal genera of this family are:

*Caberea* Lamouroux, 1816. Vicksburgian-Recent.

*Caberiella* Levinsen, 1909. Recent.

*Canda* Lamouroux, 1816. Recent.

*Scrupocellaria* Van Beneden, 1844. Lutecian-Recent.

*Bugulopsis* Verrill, 1879. Recent.

*Hoplitella* Levinsen, 1909. Recent.

*Rhabdozoum* Hincks, 1882. Recent.

*Menipea* Lamouroux, 1816. Recent.

The two genera *Caberea* and *Scrupocellaria* alone are represented in the American collections studied. *Canda* and *Scrupocellaria* are very similar. Levinsen distinguishes these genera by their ovicells and Waters by their articulation. As the method of articulation and ovicells are not preserved in the fossil forms studied, we can employ but the single genus, *Scrupocellaria* of which *S. elliptica* Reuss, 1869, *S. gracilis* Reuss, 1869, and nine new species have been recognized in American strata.

## Family FARCIMINARIIDAE Busk, 1852.

The zoecia are furnished with an obliquely ascending distal wall and separated by common, lateral walls which are furnished with a small number (two to four) of uniporous septulae; no true spines. The avicularia dependent, sometimes depressed, sometimes strongly projecting. The ovicells are endozoecial. The zoaria are dichotomously branched tufts, with slender, prismatic, sometimes jointed

segments, on which the zoëcia are arranged in longitudinal rows (generally four to six) around an axis formed by the adjoining separating walls. (After Levinsen, 1909.)

There have as yet been no anatomical researches on the representatives of the family.

The known genera are as follows, the last one alone being represented in our American collections.

*Columnaria* Levinsen, 1909. Recent.

*Farciminaria* Busk, 1852. Recent.

*Nellia* Busk, 1852. Lutecian-Recent.

We have added *Heterocella* Canu 1907, to this family because it is not yet advisable to create a distinct family for it.

#### Genus HETEROCELLA Canu, 1907.

1907. *Heterocella* CANU, Bryozoaires des terrains tertiaires des environs de Paris, *Annales de Paleontologie*, vol. 2, p. 14.

The zoarium is articulated with each segment formed of four rows of zoëcia. The opesia are always oblique; they are small on the converging zoëcia and large on the diverging ones. On the olocyst at the bottom of the zoëcia there are impressions of various forms.

*Genotype*.—*Vincularia fragilis* Defrance, 1820.

In Europe this genus has been observed only in the French Lutecian. Its constitution is still problematical, for no existing species is comparable to these fossil forms. Some of the zoëcia described by Canu as regenerated are perhaps radicular. In America one new species from the Vicksburgian of Alabama has been discovered.

#### Family EUCRATIIDAE Hincks, 1880.

Zoarium forming slender, branching, phytoid tufts. Zoëcia uniserial or in two series placed back to back; expanding from the base upwards, with a terminal or subterminal and usually oblique opesium. Neither avicularian nor vibracular appendages known. Ovicell globose hyperstomial. (Robertson.)

The genera of this family are:

*Eucratea* Lamouroux, 1812,

*Gemellaria* Savigny, 1811,

*Scruparia* Hincks, 1880,

*Huxleya* Dyster, 1858,

*Brettia* Dyster, 1858.

#### Genus GEMELLARIA Savigny, 1811.

1811. *Gemellaria* SAVIGNY, *Iconographie des Zoophytes de l'Egypte*.

Zoarium erect, branching dichotomously, each branch given off from the sides of the zoëcia close to their upper extremity. Zoëcia

joined back to back and each pair arising from the anterior extremity of the preceding pair. Opesia large, sloping slightly upward. Ovicell? (Robertson.)

*Genotype*.—*Gemellaria loricata* Linnæus, 1758.

*Gemellaria prima* Reuss, 1868, has been identified in the Upper Jacksonian of Alabama.

## Division II. COILOSTEGA Levinsen, 1909. (Opesiulæ Jullien, 1888).

The parietal muscles are attached to the ectocyst and traverse the chitinous or partially calcified cryptocyst by means of the opesiules. The hydrostatic system is zoarial but each zoecium in addition is provided with a hypostage with the cryptocyst calcified.

The families of this division represented in the American Early Tertiary are as follows:

Opesiulidae Jullien, 1888.

Subfamily Onychocellidae Jullien, 1881.

Subfamily Microporidae Hincks, 1880.

Subfamily Lunulariidae Levinsen, 1909.

Steganoporellidae Levinsen, 1909.

Thalamoporellidae Levinsen, 1909.

### Family OPESIULIDAE Jullien, 1888.

The parietal muscles are attached to the cryptocyst; their place is indicated either by pores or by lateral indentations called opesiules. The ovicell is endozoecial.

#### Subfamily ONYCHOCELLIDAE Jullien, 1881.

The ovicell is endozoecial. The parietal muscles are attached to the ectocyst. The cryptocyst is calcified. The avicularia are inter-zoecial and transformed into onychocellaria.

This subfamily includes six genera, all of which are represented by species in America:

*Onychocella* Jullien, 1881. Bathonian–Recent.

*Rectonychocella*, new genus. Jacksonian–Recent.

*Velumella*, new genus. Jacksonian–Recent.

*Diplopholeos*, new genus. Jacksonian, Vicksburgian.

*Floridina* Jullien, 1881. Senonian–Recent.

*Smittipora* Jullien, 1881. Senonian–Recent.

#### RECTONYCHOCELLA, new genus.

The retractor muscles of the polypide are attached in the median axis of the zoecia. The opesiular indentations are symmetrical. The

onychocellaria are straight, and their opesium presents a posterior part, narrow and denticulated; the mandible is composed of two membranes. The zoecium is closed by an opercular valve. The mural rim is not separated from the cryptocyst.

*Genotype*.—*Onychocella solida* Nordgaard, 1907.

*Range*.—Jacksonian—Recent.

#### VELUMELLA, new genus.

(*Velum*, sail, in allusion to the membranes of the mandibles.)

The retractor muscles of the polypide are attached in the median axis of the zoecium; the opesiular indentations are symmetrical. The onychocellaria are straight, without distal canal; the rachis of the mandible bears two broad membranes; the opesium of the onychocellarium is elliptical and entirely denticulated. The operculum is a wholly chitinized simple one, not separable from the ectocyst. Multiporous septulae. The mural rim is distinct from the cryptocyst.

*Genotype*.—*Velumella* (*Onychocella*) *levinseni*, new name.<sup>1</sup>

#### DIPLOPHOLEOS, new genus.

(*Diploos*, double; *pholeos*, den of an animal.)

The retractor muscles of the polypide are attached in the median axis of the zoecium. The lateral indentations are symmetrical and almost transformed into true opesiules. The onychocellaria are straight, their opesium is oval, with a denticulated poster; the mandible (onychocellium) is bimembranous. The mural rim is not separated from the cryptocyst. The zoecium is closed by an operculum attached to the ectocyst. The axis of rotation of the operculum is indicated by two opesial denticles. The zoecial opesia are dimorphous; one kind is elongated and the other transverse.

*Genotype*.—*Diplopholeos fusiforme*, new species.

*Range*.—Jacksonian, Vicksburgian.

#### DIPLOPHOLEOS FUSIFORME, new species.

Plate 3, fig. 2.

*Description*.—The zoarium incrusts shells and pebbles. The zoecia are hexagonal, a little elongated, separated by a narrow furrow or united among themselves by their mural rims; the cryptocyst is deep, concave, shorter than the opesium, finely granular; the polypidian convexity is protruding, wrinkled or granulated, denticulated on its opesial border; the lateral openings are deep, round, almost becoming true opesiules; the opesium is elongate, semilunate, finely crenulated. The ovicell is an inconspicuous distal convexity, sometimes limited by two lines of lateral suture. The onychocel-

<sup>1</sup> This new name is proposed for the recent species figured as *Onychocella* species by Levinsen in his Morphological and Systematic Studies on the Chelostomatous Bryozoa, 1909, pl. 22, figs. 3a-d.

larium is narrow, fusiform, somewhat larger than the zoecia; the opesium is median, oval, the point below, with a narrow and denticulated posterior; the terminal point projects above the distal zoecium, but is very fragile; the distal canal through alteration in fossilization fuses nearly always with the cryptocyst of the distal zoecium. The heteromorphic zoecia are a little smaller; their cryptocyst is longer than the opesium which then appears nearly transverse. The ancestrula is of the same form as the zoecium.

<i>Measurements.</i> —Opesium of zoecia	{	$ho=0.20$ mm. (measuring only to the polypidian convexity).
		$lo=0.15$ mm. (without the opesiules).
Zoecium	{	$Lz=0.40$ mm.
		$lz=0.30$ mm.
Opesium of onychocellaria	{	$hon=0.20$ mm.
		$lopn=0.10$ mm.
Onychocellaria	{	$Lon=0.40-0.45$ mm.
		$lon=0.20$ mm.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common).

Upper Jacksonian (Ocala limestone): Old Factory,  $1\frac{1}{2}$  miles above Bainbridge, Georgia (common).

Vicksburgian: Salt Mountain, 5 miles south of Jackson, Alabama (rare).

*Type.*—Cat. No. 62582, U.S.N.M.

#### Subfamily MICROPORIDAE, Hincks, 1880.

The ovicell is endozoecial. The parietal muscles, attached at the ectocyst, pass through the calcareous cryptocyst, either by the opesiular indentations or by true perforations called opesiules. The semi-circular aperture has generally a more or less strongly chitinized (or calcareous) simple operculum, more seldom an opercular valve. Avicularia present.

The genera comprising this subfamily are:

- Rosseliana* Jullien, 1888. Eocene–Recent.
- Floridinella*, new genus. Vicksburgian.
- Gargantua* Jullien, 1888. Miocene–Recent.
- Dacryonella*, new genus. Jacksonian.
- Aechmella*, new genus. Cenomanian–Miocene.
- Micropora* Gray, 1848. Midwayan–Recent.

**FLORIDINELLA, new genus.**

The ovicell is endozoöcial and separated from the zoöcia by a fold. The polypidian convexity is not prominent. The opesiular indentations are large and rounded. The opesium is constricted by two symmetrical lateral teeth at the level of the opercular articulation.

*Genotype*.—*Floridinella vicksburgica*, new species. Vicksburgian.

**FLORIDINELLA VICKSBURGICA, new species.**

Plate 3, fig. 3.

*Description*.—The zoarium is unilamellar, hollow, cylindrical, and incrusts the stems or small roots of algæ. The zoöcia are elongated, distinct, separated by a deep furrow; the mural rim is incomplete, rather broad, distinct from the cryptocyst. The cryptocyst is shallow, smooth or finely granular, longer than the opesium. The polypidian convexity is but slightly projecting; the opesiular indentations are large, symmetrically rounded; the opesium is elongated, constricted superiorly by two lateral teeth placed at the level of the operculum.

*Measurements*.—Opesium  $\begin{cases} ho=0.20 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{cases}$   
 Zoöcium  $\begin{cases} Lz=0.50 \text{ mm.} \\ lz=0.30-0.40 \text{ mm.} \end{cases}$

*Occurrence*.—Vicksburgian: One mile north of Monroeville, Alabama and numerous localities in the State (very abundant).

*Type*.—Cat. No. 62583, U.S.N.M.

**DACRYONELLA, new genus.**

(*Dacryon*, tear, referring to the form of the avicularia.)

The polypidian convexity protrudes very little and is inconstant. The opesiules are large, round, lateral indentations. The ovicell is endozoöcial. There are no opesial processes (therefore an opercular valve). The opesium is elongated (therefore the parietal muscles are much developed). The avicularia are very small, constant, placed in all the interzoöcial angles, and have the form of small tear drops.

*Genotype*.—*Dacryonella octonaria*, new species. Jacksonian.

This is a *Rosselliana* ornamented with avicularia. As in this genus also, the opesiules are inconstant and placed very far from the aperture in consequence of the great development of the parietal muscles.

**DACRYONELLA OCTONARIA, new species.**

Plate 3, fig. 4.

*Description*.—The zoarium incrusts small shells or more often creeps over algæ; very frequently it consists of many superposed

lamellæ. The zoecia are somewhat elongated, confluent among themselves, vaguely polygonal; the mural rim is broad, especially below, flat, smooth, oblique. The cryptocyst is terminated distally in a small polypidian convexity. The avicularia are straight, small, interopesia, triangular, projecting chiefly at the point.

*Measurements.*—Opesia of large zoecia  $\begin{cases} h_o = 0.10 \text{ mm.} \\ l_o = 0.14 \text{ mm.} \end{cases}$

Opesia of small zoecia  $\begin{cases} h_o = 0.18 \text{ mm.} \\ l_o = 0.10 \text{ mm.} \end{cases}$

Large zoecia  $\begin{cases} L_z = 0.40 \text{ mm.} \\ l_z = 0.30-0.40 \text{ mm.} \end{cases}$

Small zoecia  $\begin{cases} L_z = 0.40 \text{ mm.} \\ l_z = 0.30 \text{ mm.} \end{cases}$

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina; also at numerous localities in South Carolina and Georgia.

Upper Jacksonian: Georgia, Alabama, Florida, and Mississippi.

*Type.*—Cat. No. 62584, U.S.N.M.

#### **AECHMELLA, new genus.**

(*Aichme*, head of a lance, referring to the form of the avicularia.)

The polypidian convexity is little prominent. The opesiules are round, lateral indentations. The opesium is often contracted by two lateral teeth at the level of the opercular hinge. The ovicell is endozoecial. The avicularium is interzoecial, smaller than a zoecium, losange shaped, with the form of the head of a lance.

*Genotype.*—*Aechmella filimargo*, new species.

*Range.*—Cenomanian–Miocene.

#### **AECHMELLA FILIMARGO, new species.**

Plate 3, fig. 5.

The zoarium incrusts Orbitoides. The zoecia are elongated, distinct, separated by a furrow or united by their mural rims; the mural rim is thin, incomplete, convex, distinct from the cryptocyst. The cryptocyst is shallow, oblique towards the opesium, flat, finely granulose; the opesium is transverse, constricted by two lateral teeth at the level of the rotary axis of the operculum. The polypidian convexity projects but little; the opesiular indentations are large, round, and symmetrical. The ovicell is endozoecial and small. The ancestrula is a small zoecium, but otherwise identical with the others.



The avicularium is interzoecial, smaller than the zoecia, losange-shaped, with a small distal canal and a round opesium.

*Measurements.*—Opesium  $\left\{ \begin{array}{l} ho=0.12 \text{ mm.} \\ lo=0.16 \text{ mm. (including the opesiules).} \end{array} \right.$

Marginal zoecia  $\left\{ \begin{array}{l} Ls=0.50 \text{ mm.} \\ ls=0.30 \text{ mm.} \end{array} \right.$

Very often the proximal border of the opesium is simply undulated and the opesiules are visible only on account of the opesiular teeth. The opesia of the ovicelled zoecia seem a little larger than the others.

*Occurrence.*—Upper Jacksonian; West bank of Sepulga River, Escambia County, Alabama (rare).

*Type.*—Cat. No. 62585, U.S.N.M.

### Subfamily LUNULARIIDAE Levinsen, 1909.

#### Genus LUNULARIA Busk, 1884.

1884. *Lunularia* BUSK, Report on Polyzoa collected by *Challenger*, Cheilostomata, vol. 10, pt. 30, p. 208.

The zoarium has the Lunulites form. The avicularia are symmetrical. Exteriorly and interiorly the zoecia are arranged in radial rows. The cryptocyst is more or less developed. Both radicular and hydrostatic zoecia are present. The ovicell is endozoecial.

*Genotype.*—*Lunulites capulus* Busk, 1884.

*Range.*—Cenomanian—Recent.

*Lunulites* Lamarck, 1812, is not a definite generic type, but is merely a zoarial form adopted for certain reasons. This style of growth obtains in many genera of cheilostome bryozoa, e. g. *Otiomella* and *Trochopora* in the Anasca Malacostega; *Lunularia* and *Selenaria* in the Anasca Coilostega, and *Stichopora*, *Fedora*, and *Bipora* in the Ascophora.

Thirteen species of *Lunularia* represented in many cases by abundant specimens are known in the Lower Tertiary strata of the United States. Of these only five, *L. reversa* Ulrich, 1901, *L. distans* Lonsdale, 1845, *L. fenestrata* DeGregorio, 1890, *L. vicksburgensis* Conrad, 1847, and *L. contigua* Lonsdale, 1845, are described.

### Family ASPIDOSTOMIDAE Canu, 1908.

The zoecia have a raised margin, often indistinctly or incompletely developed. The two opesiules appear as narrow incisions, which join the zoecial aperture; the short polypide tube, which is not continued under the cryptocyst cover, is in most cases provided with marginal flanges. Avicularia are always present. Ovicells are hyperstomial.

*Rhagasostoma* Koschinsky, 1885, and *Euritina* Canu, 1900, are the only two genera of this family represented in the Early Tertiary of North America.

**Genus RHAGASOSTOMA Koschinsky, 1885.**

1885. *Rhagasostoma* KOSCHINSKY, Ein Beitrag zur Kenntniss der Bryozoen fauna der älterer Tertiärschichten Bayerns, Paleontographica, vol. 32, p. 29.

The ovicell is hyperstomial and opens above the opercular valve; it has no lateral expansions (compressed process). The avicularia are interzoecial.

*Genotype*.—*Rhagasostoma hexagonum* Koschinsky, 1885.

*Range*.—Lutecian-Miocene.

**Genus EURITINA Canu, 1900.**

1900. *Euritina* CANU, Revision des Bryozoaires du Cretace figurés par D'Orbigny, Bulletin Societe Geologique France (3), vol. 28, p. 411.

Ovicell hyperstomial, never closed by the opercular valve; avicularium interzoecial; cryptocyst well developed, with three facets separated by two longitudinal grooves; no dietellae.

*Genotype*.—*Euritina* (*Eschara*) *eurita* D'Orbigny, 1852.

*Range*.—Turonian-Eocene.

**Family STEGANOPORELLIDAE Levinsen, 1909.**

The zoecium is divided into two chambers. The proximal chamber contains the polypide and the ovaries; it is terminated by an ascending tube, the polypide tube, in which the tentacles are lodged when the polypide is retracted. The upper chamber contains the parietal and opercular muscles. The retractor muscles of the polypide are attached in one of the lower angles of the zoecium which causes the general asymmetry of the zoecium. No ovicells. No avicularia. Generally two forms of zoecia, *a* and *B*. The two opesiulae are generally not separated from the aperture of the zoecium. The operculum, which is sometimes bounded by a chitinous sclerite proximally sometimes continued immediately into the frontal membrane, is as a rule very large and then suspended by strong hinge-teeth.

**Genus STEGANOPORELLA Smitt, 1873.**

1873. *Steganoporella* SMITT, Floridan Bryozoa, Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, No. 4, p. 15.

The whole of the calcified part of the frontal area lying proximally to the aperture is a depressed cryptocyst; the aperture of the zoecium is surrounded distally and laterally by a projecting margin;

the zoecia frequently occurring in two forms, *a* and *B*, and provided with a large operculum armed with teeth, which is suspended by strong hinge-teeth; the polypide tube is never continued proximally beneath the cryptocyst cover. (After Levinsen, 1909.)

*Genotype*.—*Steganoporella* (*Membranipora*) *magnilabris* Hincks, 1880.

*Range*.—Lutecian–Recent.

Four well-marked new species have been discovered in the Jacksonian and Vicksburgian of the Southern States.

### Family THALAMOPORELLIDAE Levinsen, 1909.

The tubifer zoecia have calcareous spicula in the shape of compasses and bows. The ovicells are hyperstomial, with two calcareous layers, springing from the whole anter of the apertura; they are closed by a horizontal cup-shaped chitinized operculum which is connected at its base with the operculum of the gonozoecium. The opesiulae are always completely separated from the apertura. The opercular valve is membranous or chitinized, and more or less completely separated from the ectocyst by a single or double chitinous sclerite. Interzoecial avicularia occur.

#### Genus THALAMOPORELLA Hincks, 1887.

1887. *Thalamoporella* HINCKS, Critical Notes on the Polyzoa, *Annals Magazine Natural History* (5), vol. 19, p. 164.

Characters same as for the family.

*Genotype*.—*Thalamoporella* (*Flustra*) *rozieri* Savigny-Audouin, 1812-1826.

*Range*.—Aquitanian–Recent.

A new species occurs at the top of the Vicksburgian in Mississippi.

### Division III. PSEUDOSTEGA Levinsen, 1909.

There are no parietal muscles. The hydrostatic system is external; there is a special hypostege on each zoecium.

The families of this division are:

Membranicellariidae Levinsen, 1909.

Cellariidae Hincks, 1880.

Coscinopleuridae Canu, 1913.

#### Family CELLARIIDAE Hincks, 1880.

The whole frontal wall of the zoecia is a cryptocyst and they have a well chitinized, bilaminar, simple operculum with a straight or concave proximal margin. Within the proximal and sometimes also within the distal margin of the aperture is placed a pair of (or some-

times a single broad) supporting teeth. The subopercular area of the avicularia has an unusually strongly developed, sometimes almost complete, cryptocyst. The ovicells are endotoichal. (After Levensen, 1909.)

**Genus CELLARIA Authors.**

The zoarium is articulated, with cylindrical segments (internodes). The ovicell is endotoichal and is closed by a peculiar, chitinous operculum moved by special muscles. The operculum is formed of a chitinized inner part, closing the aperture, covered by the exterior ectocyst.

*Genotype*.—*Cellaria fistulosa* Linnaeus, 1768.

*Range*.—Jacksonian—Recent.

Several well-marked new species occur in the American Eocene.

**Family COSCINOPLEURIDAE Canu, 1913.**

The apertura is semilunar, marginated, anterior, never terminal. The ovicell is hyperstomial, embedded in the distal zoecia, never closed by the operculum. The onychocellaria are straight but typical.

The known genera are:

*Coscinopleura* Marsson, 1887.

*Escharipora* D'Orbigny, 1851.

*Macropora* MacGillivray, 1893.

?*Quadricecellaria* D'Orbigny, 1850.

**Genus COSCINOPLEURA Marsson, 1887.**

1887. *Coscinopleura* MARSSON, Die Bryozoen der Schreibkreide der Insel Rügen, Paleontologische Abhandlungen, vol. 4, p. 71.

The margins of the zoarium are bordered by large vibracula. The frontal is deprived of pores and avicularia.

*Genotype*.—*Coscinopleura* (*Eschara*) *elegans* Hagenow, 1840.

*Range*.—Cenomanian—Thanetian.

*Eschara digitata* Morton, 1834, so prolific in the upper Cretaceous (Vincentown marl) of New Jersey and Delaware is a typical species of this genus.

**Genus MACROPORA MacGillivray, 1895.**

1895. *Macropora* MACGILLIVRAY, Monograph Tertiary Polyzoa Victoria, Transactions Royal Society Victoria, vol. 4, p. 54.

In 1909 Levensen described this genus as follows:

The zoecia very thick-walled, provided with pores but without spines and without opesiules. The zoecial aperture is provided with a well-developed vestibular arch. Ovicells and avicularia wanting, but among the zoecia we find some which have an aperture of a different form and whose distal margin is furnished with three membranous feeler-like filaments. Dietellae.

*Genotype*.—*Macropora centralis* MacGillivray, 1895.

*Range*.—Eocene-Recent. Two new species in the American Eocene.

**Genus QUADRICELLARIA D'Orbigny, 1850.**

1850. *Quadricellaria* D'ORBIGNY, Paleontologie française, Terrain crétacé, Bryozoaires, vol. 5, p. 32.

Zoarium articulated; segments quadrangular; two opposite faces with large zoecia and the other two with small zoecia.

*Genotype*.—*Quadricellaria elegans* D'Orbigny.

*Range*.—Turonian-Senonian. Several new species are known in the Early Tertiary of the United States.

**Suborder ASCOPHORA Levinsen, 1909.**

The zoecial hydrostatic system is a sack or compensatrix placed under the frontal and in which the sea water is introduced. The parietal muscles are attached to this sack.

**THE COSTULAE.**

(Family Cribrilinidae Hincks, 1880.)

The zoecia have their frontal wall formed of flattened ribs ordinarily hollow, radiating from the outer border toward the median line of the zoecia, where they are intimately joined together; these ribs are united to one another, sometimes by a more or less large number of transverse passages, and sometimes border to border, the ribs, however, always remaining apparent.

Of the numerous genera referred to this family the following are represented by species in the American Tertiary:

*Membraniporella* Smitt, 1873. Cenomanian-Recent.

*Cribrilina* Gray, 1848. Midwayan-Recent.

*Puellina* Jullien, 1886. Senonian-Recent.

*Distansescharella* D'Orbigny, 1852. Senonian-Jacksonian.

*Gephyrotes* Norman, 1903. Jacksonian-Recent.

*Metracolposa*, new genus. Jacksonian.

*Corbulipora* MacGillivray, 1895. Eocene, Miocene.

*Acanthocella*, new genus. Jacksonian-Recent.

*Cribrendoecium*, new genus. Jacksonian.

*Arachnopusia* Jullien, 1886. Vicksburgian-Recent.

**METRACOLPOSA, new genus.**

(*Metra*, womb or ovicell; *kolpos*, a hollow, referring to the deeply embedded ovicell in the distal zoecia).

The costules are separated by numerous lacunae. The apertura is semilunar. The operculum in opening closes the ovicell. The ovi-

cell is large and deeply embedded in the distal zoöcia. The ovicelled zoöcia have a large apertura.

*Genotype*.—*Metracolposa robusta*, new species. Jacksonian.

**METRACOLPOSA ROBUSTA, new species.**

Plate 3, fig. 6.

*Description*.—The zoarium is free, bilamellar, large (1 to 2 centimeters in width), solid, robust. The zoöcia are distinct, elongated, elliptical; the frontal is somewhat convex; the costules are transverse at the top, radial below; they number from seven to nine pairs and are separated by four or five large lacunae; the lumen pores are small and irregular. The apertura is transverse, semielliptical with a straight or slightly convex proximal border; it is bordered distally by a very thin, incomplete peristome. The ovicell is large and deeply embedded in the distal zoöcia, elongated, salient, convex, decorated in front with a deltoid carina; it opens above the apertura and probably was closed by the operculum when it opened. The apertura of the ovicelled zoöcia is larger. A small triangular distal avicularium is placed either on the right or left of the apertura.

*Measurements*.—Apertura (ordinary)  $\left\{ \begin{array}{l} ha=0.10 \text{ mm.} \\ la=0.20 \text{ mm.} \end{array} \right.$   
 Apertura (ovicelled)  $\left\{ \begin{array}{l} ha=0.12-0.14 \text{ mm.} \\ la=0.28-0.30 \text{ mm.} \end{array} \right.$   
 Zoöcia  $\left\{ \begin{array}{l} Lz=0.96-1.00 \text{ mm.} \\ lz=0.44-0.46 \text{ mm.} \end{array} \right.$

The zoöcial width is rather variable; there are some zoöcia which measure 0.51 mm., in which case the costules are radially arranged.

The avicularia are rather rare; their point is directed toward the median axis of the zoöcia above the apertura; sometimes they are vertical; when well preserved, they have a calcareous pivot.

*Occurrence*.—Middle Jacksonian (Castle Hayne beds): Wilmington, North Carolina (very common).

*Type*.—Cat. No. 62586, U.S.N.M.

**ACANTHOCELLA, new genus.**

(*Acantha*, spine.)

The costules bear a row of very prominent lumen pores and are separated by lacunae of greater or less size. The apertura is semi-lunar. The ovicell is hyperstomial and its orifice is not in contact with the operculum.

*Genotype*.—*Cribrilina tubulifera* Hincks, 1881, from Australian seas.

*Range*.—Jacksonian—Recent.

**ACANTHOCELLA ERINACEA, new species.**

Plate 4, fig. 1.

*Description.*—The zoarium incrusts shells and bryozoa or creeps over algae. The zoecia are distinct, very slightly elongated, sub-circular; the frontal is very convex; the costules are thick, separated by the lacunae, ornamented by three, very prominent, hollow spines corresponding to the lumen pores. The apertura is semilunar with a straight proximal border; the peristome is distal and bears four large, hollow spines. The ovicell is hyperstomial, buried in the distal zoecia, globose, not closed by the operculum, ornamented with small, remote punctations.

*Measurements.*—Aperture  $\left\{ \begin{array}{l} ha=0.09 \text{ mm.} \\ la=0.11-0.12 \text{ mm.} \end{array} \right.$

Zoecia  $\left\{ \begin{array}{l} Lz=0.75-0.80 \text{ mm.} \\ lz=0.50-0.65 \text{ mm.} \end{array} \right.$

*Variations.*—The sharp points which decorate this species give it the spinous aspect of the hedge hog. It is very variable in its micro-metrical dimensions and its gemmation; the zoecia are oriented in the most unexpected and divergent manner.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Type.*—Cat. No. 62587, U.S.N.M.

**CRIBRENDOECIUM, new genus.**

(Abbreviation of "Cribrilina with endozoecial ovicell.")

The ovicell is endozoecial. The costules are separated by a small initial slit and some medium sized lacunae; they have no lumen pores. The apertura is formed of a semilunar anterior portion and a larger and concave posterior part separated by two cardelles. The apertura of the ovicelled zoecia is larger. Large interzoecial avicularia are present.

*Genotype.*—*Cribrendoecium tenuicostulatum*, new species. Jacksonian.

**CRIBRENDOECIUM TENUICOSTULATUM, new species.**

Plate 4, fig. 2.

*Description.*—The zoarium incrusts shells. The zoecia are distinct, elongated, separated by a furrow, elliptical, fusiform; the frontal is convex; the costules are very thin, numerous, without lumen pores, and separated by very small lacunae. The aperturæ of the ordinary zoecia are formed of a semilunar anterior and a very large, straight posterior part separated by two small cardelles; the apertura of the ovicelled zoecia is larger and its posterior portion is

convex. The ovicell is endozoöcial and exteriorly is prominent and transverse; it is formed of two calcareous deposits; the outer one is incomplete and leaves two lateral cicatrices in the form of a cross. The avicularia are interzoöcial and are elongated, spatulate, perforated by a long slit and generally without pivot.

*Measurements*.—Ordinary aperture  $\begin{cases} ha=0.09 \text{ mm.} \\ la=0.11 \text{ mm.} \end{cases}$

Ovicelled aperture  $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.13 \text{ mm.} \end{cases}$

Zoöcia  $\begin{cases} Lz=0.50-0.60 \text{ mm.} \\ lz=0.25-0.35 \text{ mm.} \end{cases}$

This species must not be confounded with any species of the genus *Figularia* Jullien, which is provided with a hyperstomial ovicell.

*Occurrence*.—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Type*.—Cat. No. 62588, U.S.N.M.

### Family ACROPORIDAE Canu, 1913.

The zoöcia are indistinct and their frontal is thickened. The ascopore, perforating the frontal, opens into the zoöcia below the operculum. The hyperstomial ovicell is deeply immersed and invisible exteriorly. The apertura is buried at the bottom of a long peristomie. There are some frontal avicularia and some peristomial avicularia.

The characteristics of this family are not yet sufficiently studied; the recent specimens are rare and the sections made of the fossil forms are often difficult to interpret.

We are able to distinguish the principal genera only by the nature of their frontal.

Following the Membraniporae, these are the most ancient Cheilostome fossils known.

The genera of this family and their range are indicated below: All are represented in the early Tertiary of North America.

*Acropora* Reuss, 1869. Maastrichtian–Recent.

*Gastropella*, new genus. Midwayan–Jacksonian.

*Pachytheca* Canu, 1913. Campanian–Midwayan.

*Beisselina* Canu, 1913. Cenomanian–Jacksonian.

### GASTROPELLA, new genus.

(*Gaster*, stomach; *ope*, small opening.)

An *Acropora* having a smooth frontal garnished laterally with areolae.

*Genotype*.—*Gastropella ventricosa*, new species.

*Range*.—Midwayan–Jacksonian.

*GASTROPELLA VENTRICOSA*, new species.

Plate 4, fig. 3.

*Description*.—The zoarium is free, cylindrical, bifurcated. The zoecia are large, elliptical, swollen; the frontal is smooth, convex, garnished laterally with some large areolae. The ascopore is very large, not salient, placed in the upper third of the zoecia. The peristome is salient and sharp; the peristomice is oblique, orbicular or elliptical. The ovicell is entirely hidden within the thickness of the frontal of the distal zoecium.

*Measurements*.—Peristomice  $\begin{cases} hpe = 0.10-0.15 \text{ mm.} \\ lpe = 0.15 \text{ mm.} \end{cases}$

Zoecia  $\begin{cases} Lz = 0.85 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

*Affinities*.—There is frequently a very small peristomial avicularium. On the longitudinal sections the ascopore manifestly opens below the apertura and it often appears like a large funnel. On the ovicelled zoecia there is a sort of clamp which is perhaps intended to fasten the operculum during the expulsion of the larva.

*Occurrence*.—Midwayan: Mabelvale near Little Rock, Arkansas (common).

*Type*.—Cat. No. 62589, U.S.N.M.

## Family HIPPOTHOIDEAE Levinsen, 1909.

The zoecia become calcified from behind in successive zones forward, leaving at the surface more or less salient lines, the lines of growth, and are furnished with a variable number of dietellae.

The genera of this family are as follows, those represented in American deposits being marked with an asterisk.

\* *Hippothoa* Lamouroux, 1821. Lutecian–Recent.

*Chorizopora* Hincks, 1880. Recent.

\* *Trypostega* Levinsen, 1909. Jacksonian–Recent.

*Haplopoma* Levinsen, 1909. Tortonian–Recent.

*Dacryopora* Lang, 1914. Cenomanian–Senonian.

## Family ESCHARELLIDAE Levison, 1909.

The ovicell is hyperstomial. The operculum is rigid and chitinous; it closes the aperture, the compensatrix, and often the ovicell; its form is in rapport with the hydrostatic system, and the passage of the eggs into the ovicell.

This family is the reunion of the old families of Microporellidae, Myriozoidae, and Escharidae (part) of Smitt and Hincks. Levin-

sen, in 1909, having proved the identity of the larvae formed the family of Escharellidae, but the name is badly chosen, for it is based on an archaic genus which the more recent work will not permit us to employ.

According to the form of the operculum we may class the numerous genera of this family in the following four large groups:

Schizoporellae,  
Hippoporaе,  
Peristomellae,  
Microporellae.

Evidently the hydrostatic and reproductive functions are identical in each but they operate in a quite variable manner. These variations added to those of calcification, which is also an important function, permit the establishment of a large number of genera almost all rather natural however, which facilitate the study of this very important family.

#### First Group. SCHIZOPORELLAE.

The operculum is semilunar; the proximal border bears a slit or rimule which opens the compensatrix. The muscular attachments are two small, symmetrical tuberosities more or less removed from the border. When the proximal border of the aperture is linear it serves as a pivot for the operculum; when it is arched and the rimule very large, the pivot of the operculum is formed by two projecting interior condyles.

The genera of this group with their geologic range are listed below; those marked with an \* are represented in the American Eocene and Oligocene:

- \**Schizopodrella*, new genus. Lutecian-Recent.
- \**Stephanosella*, new genus. Jacksonian-Recent.
- \**Lacerna* Jullien, 1888. Lutecian-Recent.
- \**Buffonella* Jullien, 1888. Senonian-Recent.
- \**Arthropoma* Levinson, 1909. Jacksonian-Recent.
- Phonicosia* Jullien, 1888. Helvetian-Recent.
- \**Schizomavella*, new genus. Jacksonian-Recent.
- \**Dakaria* Jullien, 1903. Lutecian-Recent.
- \**Metroperiella*, new genus. Jacksonian-Recent.
- \**Emballothea* Levinsen, 1909. Jacksonian-Recent.
- \**Tetraplaria* Tenison Wood, 1878. Jacksonian-Recent.
- Nimba* Jullien, 1903. Recent.
- Gemellipora* Smitt, 1872. Miocene-Recent.
- Characodoma* Maplestone, 1900. Miocene.

**SCHIZOPODRELLA, new genus.**

The ovicell is hyperstomial. It opens above the apertura by a special opening closed by a special membrane and without connection with the operculum; it surmounts this apertura without inclosing it. The inferior border of the apertura is somewhat concave and bears a narrow rimule. The frontal is a tremocyst direct or covering a very thin olocyst finely perforated. The muscular attachments are generally at a distance from the border of the operculum. There are oral glands.

*Genotype*.—*Schizopodrella* (*Lepralia*) *unicornis* Johnston, 1847.

*Range*.—Lutecian–Recent.

**STEPHANOSELLA, new genus.**

(*Stephanos*, crown, in reference to the crown-like border of the ovicell.)

The ovicell is hyperstomial and imbedded in the distal zoecia. It opens above the apertura by an especial orifice. The frontal is a smooth olocyst. No spines. The ovicelled zoecia have a large apertura and their avicularium is frontal.

*Genotype*.—*Stephanosella* (*Lepralia*) *biaperta* Michelin, 1845.

*Range*.—Jacksonian–Recent.

**SCHIZOMAVELLA, new genus.**

(*Schizos*, slit; *mav*, abbreviation of median avicularium.)

The operculum closes the ovicell. The muscular attachment is generally in the immediate vicinity of the border of the operculum. The rimule is wide and arched. The frontal is a tremocyst. A median avicularium occurs on the front wall. There are small oral glands.

*Genotype*.—*Schizomavella* (*Lepralia*) *auriculata* Hassall, 1842.

*Range*.—Jacksonian–Recent.

**METROPERIELLA, new genus.**

(*Metra*, womb (ovicell); *peri*, around, in reference to the ovicell entirely surrounding the apertura.)

The ovicell is hyperstomial and completely surrounds the apertura. The rimule is a large rounded sinus. The frontal is a tremocyst bearing a median avicularium.

*Genotype*.—*Metroperiella* (*Schizoporella*) *lepralioides* Calvet, 1903.

*Range*.—Jacksonian–Recent.

**METROPERIELLA BIPLANATA**, new species.

Plate 4, fig. 4.

*Description*.—The zoarium is free, formed of two flat lamellæ, back to back and inseparable. The zoecia are much elongated, distinct, fusiform; the frontal is convex and formed of a tremocyst with numerous very fine pores. The apertura is oval, formed of a semilunar anter and with a wide, rounded rimule, separated by two inner condyles. The ovicell is hyperstomial, large, globular, salient; it completely surrounds the apertura, forming about it a very pronounced peristomie, in which is placed its special orifice; the peristomie is very irregular. The median avicularium is small, little salient, in the immediate vicinity of the rimule.

*Measurements*.—Aperture  $\left\{ \begin{array}{l} ha-0.16-0.18 \text{ mm.} \\ la-0.14 \text{ mm.} \end{array} \right.$   
 Zoecia  $\left\{ \begin{array}{l} Lz-1.00-1.10 \text{ mm.} \\ lz-0.50-0.60 \text{ mm.} \end{array} \right.$

*Occurrence*.—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Type*.—Cat. No. 62590, U.S.N.M.

**Second Group. HIPPOPORÆ.**

The operculum has a projection on each side for muscular attachment; it is generally thick. The apertura bears two lateral denticles or cardelles serving as a pivot for the operculum. The ovicell is always hyperstomial.

All of the four genera comprising the Hippoporæ are represented by rather numerous species in the Early Tertiary of North America.

*Hippoporina* Neviani, 1895. Danian–Recent.

*Hippomenella*, new genus. Lutecian–Recent.

*Hippodiplosella* Canu, 1915. Jacksonian–Recent.

*Hippozeugosella*, new genus. Priabonian–Miocene.

**HIPPOMENELLA**, new genus.

(*Hippos*, horse; *mene*, moon, referring to the horseshoe form of the apertura and to the areas which decorate the ovicell.)

The apertura bears two small cardelles placed very low and separating a large porta from a small vanna; it is always semi-elliptical (in the interior). The ovicell, hyperstomial, is deeply imbedded in the distal zoecia; it opens by a large opening above the apertura, but it is never closed by the operculum. The frontal is formed of an olocyst perforated laterally by some areolæ and supporting a pleurocyst more or less developed. The ovicell bears

laterally two areas in the form of a lunar crescent and more or less perforated. There are nearly always some spines and some avicularia.

*Genotype*.—*Hippomenella* (*Lepralia*) *mucronelliformis* Waters, 1899.

*Range*.—Lutecian-Recent.

#### HIPPOZEUGOSELLA, new genus.

(*Hippos*, horse, in reference to the horseshoe form of the aperture; *zeugos*, a pair, referring to the arrangement of the zoecia.)

The ovicell is hyperstomial, its orifice is large, without rapport with the operculum, and is closed by a special membrane. The aperture is elliptical; two small cardelles separate the anter from the somewhat smaller poster. The frontal is a tremocyst with small pores. The zoarium is free; the zoecia are joined two by two. No spines. Avicularia present.

*Genotype*.—*Hippozeugosella* (*Bactridium*) *hagenowi* Reuss 1847.

*Range*.—Priabonian-Miocene.

#### HIPPOZEUGOSELLA TEGES, new species.

Plate 4, fig. 5.

*Description*.—The zoarium is free, erect, unilamellar, formed of two longitudinal rows of zoecia; on the dorsal the zoecia are convex, alternate, and have the aspect of a mat. The zoecia are distinct, elongate, hexagonal; the frontal is convex and formed of a tremocyst with very small pores. The apertura is orbicular and formed of a large anter, and with a smaller poster separated by two very small cardelles; the peristome is complete, broad, and infundibuliform. On the peristome itself and near the zoarial axis there is a small round avicularium provided with a pivot. Ovicell!

*Measurements*.—Aperture  $\begin{cases} ha=0.11 \text{ mm.} \\ la=0.11 \text{ mm.} \end{cases}$

Zoecia  $\begin{cases} Lz=0.70-0.75 \text{ mm.} \\ lz=0.45 \text{ mm.} \end{cases}$

*Affinities*.—The frontal pores are very small and are easily filled up. The frontal and the dorsal are covered with very small granulations. The formation of the branches is effected by the union of two zoecia arising from two superposed zoecia.

*Occurrence*.—Upper Jacksonian (Zeuglodon zone); Cocoa post office, Choctaw County, Alabama (very rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common).

*Type*.—Cat. No. 62591, U.S.N.M.

## Third Group. PERISTOMELLAE.

The apertura is oblique without lyrule, cardelles, or rimule. The ovicell is hyperstomial and imbedded in the distal zoëcia. It opens above (and nearly opposite) the oblique apertura and below the frontal mucro in a locella where the operculum operates.

The principal genera of this group are listed below with their range; all occur in the North American Eocene and Oligocene.

*Bathosella*, new genus. Cretaceous-Midwayan.

*Romancheina* Jullien, 1888. Jacksonian-Recent.

*Peristomella* Levinsen, 1902. Lutecian-Recent.

*Exochella* Jullien, 1888. Rocanean-Recent.

*Didymosella*, new genus. Vicksburgian-Recent.

## BATHOSELLA, new genus.

(*Bathos*, depth.)

The apertura is oblique, without lyrule, cardelles, or rimule. The ovicell is embedded in the distal zoëcia. It opens above the apertura and below the frontal mucron in the locella. The frontal is a thick olocyst, more or less covered by a pleurocyst. The zoëcia are indistinct. The avicularia are simple and irregularly placed. The areolae are very rare. No spines.

*Genotype*.—*Bathosella* (*Mucronella*) *aspera* Ulrich, 1901.

*Range*.—Uppermost Cretaceous, Midwayan.

## DIDYMOSELLA, new genus.

(*Didymos*, double, having reference to the two large frontal pores.)

The frontal is a tremocyst. Below the apertura there are two large pores which open into the zoëcia under the operculum. Spines. There is a large marginal avicularium, triangular, with pivot, arranged transversally.

*Genotype*.—*Didymosella* (*Porina*) *larvalis* MacGillivray, 1868.

*Range*.—Vicksburgian-Recent.

## DIDYMOSELLA CRASSA, new species.

Plate 4, fig. 6.

*Description*.—The zoarium is unilamellar and very thick; it creeps over algae. The zoëcia are elongated, distinct, in the form of a bottle; the frontal is convex and formed of a tremocyst with large, crowded tubular pores. The apertura is elliptical and transverse; the salient peristome bears the traces of very small spines; two enormous pores are adjacent to the peristome. The avicularium is marginal, triangular, very large, with pivot, and arranged trans-

versely. The lower face is smooth and presents some large, scattered concavities.

*Measurements.*—Aperture  $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.11-0.12 \text{ mm.} \end{cases}$   
 Zoecia  $\begin{cases} Jz=0.60-0.70 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

*Variations.*—In longitudinal section we are better able to comprehend the organization of this species. In particular the dorsal wall is a very thick olocyst, the cavities observed on the exterior do not perforate it; they limit the zoecia between which they are hollowed out. The large frontal pores open into the same zoecia; the tremopores are tubules; finally, the avicularium is a very large chamber hollowed in the thickness of the frontal wall.

*Occurrence.*—Vicksburgian: West bank of Conecuh River, Escambia County, Alabama (common).

*Type.*—Cat. No. 62592, U.S.N.M.

#### Fourth Group. MICROPORELLAE.

Genera of this group are not represented in the Early Tertiary.

#### DIVERS GENERA.

The genera listed under this heading have some peculiar characters which do not permit of their classification in any of the large groups cited; but they appear really to belong to the same general family.

The principal genera, with their ranges and American occurrence (marked \*) are:

\* *Houzeauina* Pergens, 1889. Jacksonian, Priabonian.

\* *Cyclicopora*, Hincks, 1884. Jacksonian-Recent.

*Kymella*, new genus. Recent.

*Anarthropora* Smitt, 1867. Latdorian-Recent.

\* *Amulosia* Jullien, 1888. Wilcoxian-Recent.

#### KYMELLA, new genus.

(*Kyma*, undulation, in allusion to the undulated form of the proximal border of the operculum.)

The hyperstomial ovicell is always closed by the operculum. The frontal is bordered laterally by areolae. The apertura bears a very wide rimule.

*Genotype.*—*Kymella (Cyclicopora) polaris* Waters, 1904. Recent.

#### STOMACHETOSELLIDAE, new family.

The frontal is thick and occasions the formation of a peristomie. The apertura is generally orbicular or semilunar with a very concave proximal border. The peristomie is always different in form;

it is notched below by a rimule-spiramen designed to conduct the water into the compensatrix. The ovicell is hyperstomial, embedded in the distal zoöcia; it opens above the apertura in the peristomie. No peristome, lyrule, or cardelles.

This family differs from the Reteporidae in the absence of vibices, vacuoles, and reticulated zoarium, in the cleft on the ovicell, and in the presence of a peristomie. It resembles this family in its embedded ovicell and its rimule-spiramen.

It differs from the Smittinidae in the absence of lyrule, cardelles, median avicularium, and of a peristome with spines. It possesses the same embedded ovicell opening into the peristomie. In the Smittinidae the peristomie is formed by the development of a peristome with spines; in the Stomachetosellidae it is formed by the thickening of the frontal.

We have founded our generic classification on the aspect of the ovicell and on the variations of the escape of the larvae, an important function. All the other functions, reproduction, hydrostatic, calcification, and passage of the eggs remain exactly the same.

#### STOMACHETOSELLA, new genus.

(*Stoma*, mouth; *ochetos*, small canal.)

The ovicell entirely surrounds the apertura. The frontal is a tremocyst with wide-mouthed tubules. No avicularia. The peristomie of the ovicelled zoöcia possesses a straighter rimule-spiramen.

*Genotype*.—*Stomachetosella crassicollis*, new species. Vicksburgian.

#### STOMACHETOSELLA CRASSICOLLIS, new species.

Plate 4, fig. 7.

*Description*.—The zoarium is free, bilamellar, formed of broad, undulated branching fronds, more or less flabelliform. The zoöcia are elongated, little distinct; the frontal is convex, smooth, thick, and salient around the apertura, and formed by a tremocyst with large tubules resting on a thin olocyst. The apertura (interior) is orbicular; the peristomie is provided with a triangular rimule-spiramen; the false peristome is thick and smooth. The ovicell is hyperstomial, buried, globular, salient, ornamented with tubular tremopores; it opens into the peristomie; it is possibly closed by the operculum (?); the rimule-spiramen of the ovicelled zoöcia is longer and linear. Laterally, near the apertura there is often a triangular, improminent avicularium, the beak directed above, with pivot.

*Measurements.*—Peristomice (exterior)  $\begin{cases} hpe=0.10-0.15 \text{ mm.} \\ lpe=0.15-0.20 \text{ mm.} \end{cases}$   
 Apertura (interior)  $\begin{cases} hpe=0.12-0.15 \text{ mm.} \\ lpe=0.12-0.15 \text{ mm.} \end{cases}$   
 Zoœcia  $\begin{cases} Lz=0.90 \text{ mm.} \\ lz=0.30-0.40 \text{ mm.} \end{cases}$

This species with its enormous, solid walls, appears robust and resistant. Nevertheless, this is not the case. It was rapidly exterminated and never had a large geographic distribution. This is frequent in the bryozoa, where pliancy is a better sign of longevity and resistance.

*Occurrence.*—Vicksburgian: West bank Conecuh River, Escambia County, Alabama (very common).

*Type.*—Cat. No. 62593, U.S.N.M.

#### ENOPLOSTOMELLA, new genus.

(*Enoplis*, armed; *stoma*, mouth.)

The apertura and peristomice of the ovicelled zoœcia are identical with the apertura and peristomice of the ordinary zoœcia. The frontal is a tremocyst with wide-mouthed tubules. The ovicell does not entirely surround the peristomice. There is an avicularium in the peristomie in the immediate vicinity of the peristomice.

*Genotype.*—*Enoplostomella defixa*, new species.

*Range.*—Jacksonian-Vicksburgian.

#### ENOPLOSTOMELLA DEFIXA, new species.

Plate 4, fig. 8.

*Description.*—The zoarium is free, cylindrical, vinculariform, formed of from 6 to 7 longitudinal rows of zoœcia. The zoœcia are indistinct; the frontal is little thickened, convex, formed of a tremocyst with large tubules placed above an olocyst with pores. The apertura (interior) is formed of a semilunar anter and of a concave poster; the peristomice (exterior) is elongated, embedded, provided with a triangular rimule-spiramen. The ovicell is hyperstomial, buried in the distal zoœcia, globular, salient, decorated with large tremopores; it opens largely into the peristome. The oral avicularium is adjacent to the peristomice and placed somewhat obliquely; it is triangular, rather long, and provided with a pivot; the beak is turned outward.

*Measurements.*—Apertura (interior)  $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$   
 Peristomice (exterior)  $\begin{cases} hpe=0.14-0.16 \text{ mm.} \\ lpe=0.18-0.20 \text{ mm.} \end{cases}$   
 Zoœcia  $\begin{cases} Lz=0.90-1.00 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

*Occurrence*.—Vicksburgian; 1 mile north of Monroeville, Alabama (very common).

*Type*.—Cat. No. 62594, U.S.N.M.

**SCHIZEMIELLA, new genus.**

(*Schizos*, slit; *emi*, abbreviation of peristomie.)

The frontal of the ovicell is very fragile. The apertura is schizoporellidan with wide rimule. The rimule-spiramen is inconstant. The tubules are reunited on their commonage.

*Genotype*.—*Schizemiella claibornica*, new species. Claibornian.

**SCHIZEMIELLA CLAIBORNICA, new species.**

Plate 4, fig. 9.

*Description*.—The zoarium is free, bilamellar with inseparable lamellae. The zoecia are indistinct; the frontal is thickened, little convex, formed of a tremocyst with large irregular tubules placed on a thin olocyst with very small pores in quincunx. The apertura is formed of an ogival anter and a concave poster with a very wide rimule; the peristomie is elongated, embedded, with a very wide, irregular rimule-spiramen. The ovicell is hyperstomial and opens largely into the peristomie; it is little globular, hardly salient; covered by a smooth or perforated, very fragile wall; the peristomie is elliptical and transverse. The avicularium is triangular, the beak directed above, adjacent to the peristomie which it deforms, provided with a pivot.

*Measurements*.—Peristomie (exterior)  $\left\{ \begin{array}{l} hpe=0.20 \text{ mm.} \\ lpe=0.14-0.16 \text{ mm.} \end{array} \right.$

Apertura (interior)  $\left\{ \begin{array}{l} ha=0.12 \text{ mm.} \\ la=0.11 \text{ mm.} \end{array} \right.$

Zoecia (interior)  $\left\{ \begin{array}{l} Lz=0.54 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array} \right.$

*Variations*.—In the interior the tremopores are regularly placed in quincunx; on the exterior they are very irregularly disposed, larger and less numerous.

The rimule of the peristomie is very irregular. In reality the form of the apertura belongs to the group of very typical *Schizoporella* and the operculum ought to be chitinized enough to insure sufficiently the opening of the compensatrix by itself.

*Occurrence*.—Claibornian (Gosport); Claiborne, Alabama (rare). One mile west of Rockville, Clarke County, Alabama (rare).

*Type*.—Cat. No. 62595, U.S.N.M.

**METRADOLIUM, new genus.**

(*Metra*, womb; *dolios*, deceptive, having reference to the deceptive aspect of the ovicells.)

The ovicelled zoöcia, different in form from the others, have a peristomice in the form of a lunar crescent without rimule-spiramen. The frontal is a tremocyst with tubules.

*Genotype*.—*Metradolium dissimilis*, new species. Jacksonian.

**METRADOLIUM DISSIMILIS, new species.**

Plate 4, fig. 10.

*Description*.—The zoarium is free, bilamellar, branching; the fronds are wide, thick, distorted or undulated, dichotomous. The zoöcia are distinct, elongated, elliptical. The frontal is a tremocyst with tubules resting on an olocyst with very small pores corresponding to the tubules. The peristomie is deep and very oblique; the apertura is small and suborbicular; the peristomice is orbicular; the spiramen is median, more or less distant from the peristomice. There are two oral avicularia symmetrically placed but dissimilar in form and size; the smaller is round, simple, nonsalient; the larger is enormous, oval, salient, with pivot. The ovicell is enormous, buried in the distal zoöcia, hyperstomial but opening largely into the peristomie; salient and globular; its peristomice has the form of a lunar crescent; the ovicelled zoöcia bear only a small avicularium with pivot.

*Measurements*.—Peristomice (exterior)  $\left\{ \begin{array}{l} h_{pe}=0.14-0.16 \text{ mm.} \\ l_{pe}=0.15-0.20 \text{ mm.} \end{array} \right.$

Zoöcia (exterior)  $\left\{ \begin{array}{l} L_z=0.74-0.76 \text{ mm.} \\ l_z=0.40-0.50 \text{ mm.} \end{array} \right.$

*Occurrence*.—Middle Jacksonian: Wilmington, North Carolina (very common), and various localities in South Carolina and Georgia.

*Type*.—Cat. No. 62596, U.S.N.M.

**LEIOSELLA, new genus.**

(*Leios*, smooth, having reference to the nature of the frontal.)

The frontal is an olocyst. The peristomice of the ovicelled zoöcia is of different form from that of the other zoöcia; it is a lunar crescent and deprived of rimule-spiramen.

*Genotype*.—*Leiosella rostrifera*, new species. Vicksburgian.

This genus differs from *Metradolium* only in the nature of the frontal, which is here a very thick olocyst.

**LEIOSELLA ROSTRIFERA, new species.**

Plate 5, fig. 1.

*Description*.—The zoarium is free, bilamellar; the fronds are narrow, flat, claviform, bifurcated. The zoöcia are elongated, distinct, ovoid; the frontal is smooth, convex, formed by a thick olocyst. The peristomice is irregular; the rimule-spiramen is bordered laterally

by the oral avicularium. The apertura is elongated, ovoid, very oblique. The oral avicularium is large, transverse, salient, with the beak strong and curved; it is provided with a pivot and a large mandible, more or less spatulate. On the frontal there are two small, elliptical avicularia with round mandible.

*Occurrence*.—Vicksburgian: One mile north of Monroeville, Alabama (very common).

*Type*.—Cat. No. 62597, U.S.N.M.

#### METROCRYPTA, new genus.

(*Metra*, womb, in reference to the ovicell; *cryptos*, hidden.)

The frontal is a tremocyst with tubules. The rimule-spiramen is wide and of very little depth. Ovicell unknown.

*Genotype*.—*Metrocrypta bucculenta*, new species. Jacksonian.

The ovicell of this genus is unknown; it is therefore very doubtful that the genus should be introduced into this family. The oral avicularium is very rare; however, its presence seems to us the best character for classification.

#### METROCRYPTA BUCCULENTA, new species.

Plate 5, fig. 2.

*Description*.—The zoarium is free, cylindrical, bifurcated. The zooecia are elongated, large, little distinct; the frontal is convex, porous, formed of a tremocyst placed on a thick olocyst. The peristomice is somewhat elongated, oval, its lower point formed of a wide rimule-spiramen; the peristomie is somewhat salient; the apertura (interior) is much smaller, orbicular, very oblique. The oral avicularium is very rare; it is quite large, prominent, triangular, adjacent to the peristomie, provided with a pivot placed very low.

*Measurements*.—Peristomice (exterior)  $\left\{ \begin{array}{l} hpe = 0.30-0.35 \text{ mm.} \\ lpe = 0.30 \text{ mm.} \end{array} \right.$

Apertura (interior)  $\left\{ \begin{array}{l} ha = 0.15 \text{ mm.} \\ la = 0.15 \text{ mm.} \end{array} \right.$

Zooecia  $\left\{ \begin{array}{l} Lz = 1.00 \text{ mm.} \\ lz = 1.25 \text{ mm.} \end{array} \right.$

*Occurrence*.—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Type*.—Cat. No. 62598, U.S.N.M.

#### OCHETOSELLA, new genus.

(*Ochetos*, small canal.)

The ovicell is hyperstomial and deeply embedded in the distal zooecium. The rimule-spiramen is replaced by a small canal sup-

ported by a peristomial projection. The frontal is an olocyst perforated laterally by some areolae and covered by a uniform pleurocyst.

*Genotype*.—*Ochetosella jacksonica*, new species.

*Range*.—Claibornian, Jacksonian.

At first glance, this genus appears close to *Palmicellaria*, but this is an error. The large avicularian mucro of that genus is replaced here by a small canal which is evidently the equivalent of the rimule-spiramen of the other genera of the family Stomachetosellidae. When it exists, the oral avicularium is indeed in its place in the immediate vicinity of the peristome and of the rimule-spiramen.

**OCHETOSELLA JACKSONICA, new species.**

Plate 5, fig. 3.

*Description*.—The zoarium is free, erect, cylindrical, bifurcated, often anastomosing. The zoecia are elongated, distinct, hexagonal, separated by a salient thread; the frontal is concave, bordered by large areolae, formed of a thin olocyst and covered by a uniform and finely granulated pleurocyst. The apertura is semilunar and invisible externally; the peristome is very oblique, with undefined outlines, vaguely triangular. The ovicell is globular and deeply embedded in the distal zoecia. The oral avicularium is rare.

*Measurements*.—Zoecia  $\begin{cases} Lz=1.10-1.20 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{cases}$

*Occurrence*.—Upper Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (very rare).

Lower Jacksonian: Jackson, Mississippi (very common).

Middle Jacksonian: Wilmington, North Carolina (very common), and various localities in South Carolina and Georgia.

*Type*.—Cat. No. 62599, U.S.N.M.

**Family SMITTINIDAE Levinsen, 1909.**

The ovicell which is hyperstomial and embedded in the distal zoecia opens into the peristome. The peristome is produced and channeled in front. The operculum is (not universally) very thin; the lower edge is straight or slightly curved inward and hardly separated from the ectocyst; the muscular attachments are usually a ridge on the border. There are very small oral glands often partly attached to the tentacular sheath. Spines.

This family is a very natural one, but unfortunately our knowledge of the anatomy and embryology is too slight to allow us to fix its exact limits. The development of the peristome is one of the essential characters; we continue to employ the same terminology as for the preceding families. The orifice of the peristome is the

peristomie (secondary orifice of Hincks); it is irregular and its outlines are vague and undefined. The apertura is the zoecial orifice closed by the operculum; it is not always visible externally. The internal tube formed by the development of the peristome is the peristomie.

The calcification functions as in other genera. Nevertheless the pleurocyst is a frequent occurrence, and the greater part of the time the two calcareous layers are separable.

#### Genus SMITTINA Norman, 1903.

1880. *Smittia* HINCKS, British Marine Polyzoa, p. 340 (preoccupied).

1903. *Smittina* NORMAN, Notes on the Natural History of East Finmark, Annals and Magazine Natural History (7), vol. 12, p. 120.

In the apertura there is a lyrule and two cardelles. The frontal is an olocyst, perforated laterally with areolae and supporting a granular or costulate pleurocyst. The anterior indentation of the peristome contains an avicularium very often triangular.

*Genotype*.—*Smittina* (*Lepralia*) *reticulata* MacGillivray.

*Range*.—Lutecian–Recent.

This genus is represented in the American Early Tertiary by 14 new species and by *Smittina tubulata* Gabb and Horn, 1862, from the Vicksburgian, *S. strombecki* Reuss, 1866, from the Middle and Upper Jacksonian, and *S. angulata* Reuss, 1866, from the Jacksonian and Vicksburgian.

#### PLAGIOSMITTIA, new genus.

(*Plagios*, transverse, referring to the zoecial arrangement.)

The ovicell opens into the peristomie. The frontal is a tremocyst. The avicularium is placed in the peristomie. The zoecia are oriented transversally to the zoarial fronds.

*Genotype*.—*Plagiosmittia regularis*, new species. Jacksonian.

This genus differs little from *Porella* Gray, 1848, in the nature of its functions. The difference lies in the irregularity of the place of the median avicularium and in the disposition of the zoecia on the fronds. Possibly it should be considered only a subgenus.

#### PLAGIOSMITTIA REGULARIS, new species.

Plate 5, fig. 4.

*Description*.—The zoarium is bilamellar; the fronds are flat, narrow bifurcated. The zoecia are much elongated, distinct, separated by a thread or a furrow, and are much narrowed proximally. The frontal is flat or little convex, and formed of a tremocyst with numerous crowded pores. The peristome is thin, salient; the aperture

is semilunar, with a very concave proximal border; the peristomie is irregular, but it often contains a false rimule limited by the avicularium. The ovicell is globular, little salient; it is formed of a large circular area with small numerous pores, surrounded by an improminent smooth collar; it is embedded in the distal zoecia and opens into the peristomie. The avicularium is peristomial, placed more or less laterally; the mandible moves in the peristomie.

*Occurrence*.—Middle Jacksonian: Wilmington, North Carolina (common).

Upper Jacksonian (Ocala limestone): Old factory, one-half mile above Bainbridge, Georgia (rare).

Vicksburgian: Salt Mountain, 5 miles south of Jackson, Alabama (very rare).

*Type*.—Cat. No. 62600, U.S.N.M.

#### Genus MUCRONELLA Hincks, 1880.

1880. *Mucronella* HINCKS, British Marine Polyzoa, p. 360.

The frontal is surrounded by areolae and covered by a pleurocyst, costulate or granular. There is a lyrule, and often some cardelles, in the peristomie inferiorly.

*Genotype*.—*Mucronella (Leprulia) peachi* Johnston, 1847.

*Range*.—Jacksonian-Recent.

The limits of this genus were rigorously established in 1904 by Waters. It differs from *Smittina* in the replacement of the avicularium by a mucro; that is to say, by an organ which we know to be almost equivalent. Several new species are known in our American Early Tertiary.

#### Genus RHAMPHOSTOMELLA Lorenz, 1886.

1886. *Rhamphostomella* LORENZ, Bryozoen von Jan Mayen, Die Oesterreichische Polarstation, Jan Mayen, vol. 3, p. 11.

The operculum closes the ovicell, which is hyperstomial; it is thin and delicate, but there is a raised circular ridge. There is a very narrow lyrule before an asymmetrical sinus. The frontal is an olocyst with costules. Before the orifice of the ovicell, and at the same height, there is a very large avicularium, oblique, salient, and placed eccentrically. Eighteen tentacles. The oral glands are much developed.

*Genotype*.—*Rhamphostomella costata* Hincks, 1889.

*Range*.—Priabonian-Recent.

A new variety of *Rhamphostomella brendolensis* Waters, 1891, and two new species occur in the American Eocene.

**CYSTISELLA, new genus.**

(Cystis, bladder, pouch.)

The frontal is an olocyst. It bears a very wide avicularian chamber in which there is a pair of large glands. The mandibles have a lucida in the middle. (Waters).

*Genotype*.—*Cystisella* (*Porella*) *saccata* Busk, 1856.

*Range*.—Midwayan—Recent.

"In *Porella saccata* it [the ovicell] is many-layered, as thin calcareous layers, presumably gymnocyst [our olocyst] layers, continually grow over the oecium, not only from the distal zoecium but also from the two neighboring zoecia, and we can see, as a rule, three, distinctly separated, thin covering plates on their surface."<sup>1</sup>

**CYSTISELLA MIDWAYANICA, new species.**

Plate 5, fig. 6.

*Description*.—The zoarium incrusts shells. The zoecia are distinct, somewhat elongated, hexagonal, separated by a furrow or a thin salient thread; the frontal is very convex and very finely granulated. The peristome is thin, little salient in its distal part; it bears some spines; the peristomie is elliptical and deformed inferiorly by the avicularium. The avicularium forms a long chamber, median and conical; its orifice is little circular and turned toward the apertura.

*Measurements*.—Peristomie  $\left\{ \begin{array}{l} hpe = 0.10 \text{ mm.} \\ lpe = 0.14 \text{ mm.} \end{array} \right.$

Zoecia  $\left\{ \begin{array}{l} Lz = 0.40 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{array} \right.$

*Occurance*.—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (very rare).

One mile west of Fort Gaines, Georgia (rare).

*Type*.—Cat. No. 62902, U.S.N.M.

**Genus PORELLA Gray, 1848.**

1848. *Porella* GRAY, List of British Animals in collection British Museum. Centroniae, pp. 127, 148.

The ovicell opens into the peristomie; it is porous, imbedded in the distal zoecium. The apertura is semilunar. Neither lyrule nor cardelles. The operculum is almost straight in its proximal part, with rounded corners; there is a muscular prominence a little distance from the edge. In front of the apertura there is an avicularium; the mandible is semicircular and has well-marked thickenings

<sup>1</sup> Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 336.

formed of diagonal bars. The frontal is a tremocyst with tubules. Twenty tentacles.

*Genotype*.—*Porella (Millepora) cervicornis* Pallas, 1766.

*Range*.—Lutecian–Recent.

This genus differs from *Smittina* only in the calcification; the tremocyst replaces the pleurocyst. There are, however, some other secondary differences. The mandible of the avicularium is semi-circular; it is generally (but not universally) triangular in *Smittina*.

This is a prolific genus in the Early Tertiary of North America, 15 new species being known, represented in most cases by abundant specimens.

#### Genus UMBONULA Hincks, 1880.

1880. *Umbonula* HINCK, British Marine Polyzoa, p. 316.

There is neither lyrule nor cardelles. The apertura is suborbicular. The ovicell is hyperstomial and opens largely above the apertura. The frontal is a pleurocyst with costules surrounded by areolae. A prominent umbo immediately below the mouth, supporting an avicularium.

*Genotype*.—*Umbonula (Cellepora) verrucosa* Esper, 1791.

*Range*.—Lutecian–Recent. Represented by two species in the Vicksburgian of Alabama.

#### Genus PHOCEANA Jullien, 1903.

1903. *Phoceana* JULLIEN, Bryozoaires provenant des Campagnes de l'*Hirondelle*, p. 107.

The apertura is semicircular with poster slightly concave; it is deprived of cardelles and bears a pseudolyrule formed by the elevation of the peristomial wall. The operculum bears a chitinous mural rim incomplete at the level of the convexity of the upper border and little removed from the lateral borders.

*Genotype*.—*Phoceana columnaris* Jullien, 1903.

*Range*.—Jacksonian–Recent.

#### HIPPADENELLA, new genus.

(*Aden*, gland.)

The frontal is a pleurocyst surrounded by areolae. The apertura bears two cardelles. The mandibles have a lucida in the middle. The avicularian chamber shows a double glandlike body and the protoplasmic mass.

*Genotype*.—*Hippadenella (Flustra) margaritifera* Quoy and Gaymard, 1833. Recent.

It seems to us that it would be better to classify this genus in the Hippoporinae, although all the authors are agreed in considering

the genotype as belonging to the genus *Porella*; we can not maintain it there, the frontal being a pleurocyst and the apertura bearing cardelles.

### Family RETEPORIDAE Smitt, 1867.

The ovicell is hyperstomial, much immersed in the distal zoecium; it is largely open into the peristomie. The zoarium is generally reticulate; the dorsal face presents some projections or vibices without connection with zoecia and contains interiorly some kenozoecia (lacunae of Waters) more or less numerous and elongated. The reteporidan pore placed in front of the apertura is according to its situation an ascopore or a spiramen; 11 to 16 tentacles.

#### Genus RETEPORA Imperato, 1859.

1859. *Retepora* IMPERATO, Dell' historia naturale, book 28.

"This group has a fissure in the ovicell. The proximal edge of the operculum is nearly straight, and very similar throughout this group; labial avicularia occur in some but not in all. The oral glands are very well developed" (Waters). The reteporidan pore is a spiramen.

*Genotype*.—*Retepora cellulosa* Linnæus-Smitt, 1867.

*Range*.—Jacksonian-Recent.

#### HIPPELLOZOON, new genus.

(*Hippos*, horse, referring to the horseshoe shape of the apertura.)

The ovicell is widely open. There is neither labial avicularium nor reteporidan pore. The operculum is contracted in the middle, having long bands at the sides for the muscular attachments; the proximal edge is not straight. The apertura has two cardelles.

*Genotype*.—*Hippellozoon* (*Retepora*) *novezelandiae* Waters, 1894. Recent.

#### SCHIZELLOZOON, new genus.

(*Schizos*, slit).

The ovicell is widely open and provided with a semicircular slit. It has neither labial avicularium nor reteporidan pore. The operculum has a broad thickened border; the proximal edge is not straight. The poster of the apertura bears a wide little deep sinus.

*Genotype*.—*Schizellozoon* (*Retepora*) *imperati* Busk, 1884. Recent.

The spiramen (reteporidan pore of Waters) is replaced by a pseudospiramen which is a groove in the proximal lip of the peristomie.

## TRIPHYLLOZOOM, new genus.

(*Triphyllon*, trifoliate, alluding to the trifoliate ovicell.)

"The ovicell has a 'trifoliate stigma.' There is generally a minute avicularium on the lip to one side. The opercula generally are fairly similar with a nearly straight proximal edge, and in shape rather wider than long, with the muscular attachments rather high up and near the border. Apparently all have the labial pore which is often the end of a long tube opening into the zoecium (=ascopore) proximally to the operculum" (Waters).

*Genotype.*—*Triphyllozoon* (*Retepora*) *moniliferum* MacGillivray, 1860. Recent.

## Genus RHYNCHOZOOM Hincks, 1891.

1881. *Rhynchopora* HINCKS, British Marine Polyzoa, p. 385. (Preoccupied, replaced by *Rhynchozoon* in 1891.)

"This genus seems to be characterized by the possession of a more or less well-developed sinus on the apertura, by its ovicell which has an entire frontal surface, and is provided with an incomplete oöcial cover, and by the possession of pore-chambers (dietellæ)." (Levinson.)

*Genotype.*—*Rhynchozoon* (*Lepralia*) *bispinosa* Johnston, 1849. Recent.

## Genus SCHIZOTHECA Hincks, 1877.

1877. *Schizotheca* HINCKS, On British Polyzoa, pt. 2, Classification, Annals Magazine Natural History (4), vol. 20, p. 528; 1880, British Marine Polyzoa, p. 283.

"Zoöcia with a suborbicular primary orifice, the lower margin sinuated; the secondary orifice raised, tubular, notched in front. Ovicell terminal, with a fissure in the front wall, never closed by the operculum."

*Genotype.*—*Schizotheca* (*Lepralia*) *fissa* Busk, 1856. Recent.

Levinson classified this genus in the Reteporidae, where we also believe it better placed.

## Family GALEOPSIDAE Jullien, 1903.

The ovicell is hyperstomial and opens into the peristomie above the operculum. A spiramen introduces into the peristomie the water destined afterwards for the compensatrix.

In the family of the Adeonidae as in that of the Reteporidae this spiramen also exists; it is in evident relation with the hydrostatic system; it might have another use, another function unfortunately still unknown. It is not possible, for example, to compare the size of the spiramen of *Galeopsis* with the smallness of the orifice of the compensatrix simply closed by a rimule or by a poster of an oper-

culum. On the other hand, it is quite frequent to find on the same zoarium some zoecia deprived of spiramen, and which nevertheless are still living and contain a polypide.

### Genus GALEOPSIS Jullien, 1903.

1903. *Galeopsis* JULLIEN, Bryozoa provenant des Campagnes de l'*Hirondelle*, p. 94.

The spiramen is very large and salient. The apertura has two cardelles. The frontal is a tremocyst or an olocyst.

*Genotype*.—*Galeopsis ravidus* Jullien, 1903.

*Range*.—Maestrichtian—Recent.

Several new species of this well-marked genus are known in the American Early Eocene.

### SCHIZAROPSIS, new genus.

(*Schizos*, slit; *opsis*, appearance.)

The apertura bears a straight proximal border notched by a small rectilinear rimule. The frontal is garnished laterally with areolae; it is formed of a very finely granulated pleurocyst placed on a thick olocyst. The spiramen is almost as large as the peristomie.

*Genotype*.—*Schizaropsis convexa*, new species. Jacksonian.

### SCHIZAROPSIS CONVEXA, new species.

Plate 5, fig. 7.

*Description*.—The zoarium incrusts oysters; the zoecia are grouped in linear longitudinal lines. The zoecia are distinct, a little elongated, elliptical, or rectangular; the frontal is very convex, smooth, or very finely granular, bordered laterally with six large widely spaced areolae. The apertura is formed of a semilunar anter and of a straight proximal border notched by a small rectilinear rimule. The spiramen is elliptical, transverse, placed on the exterior peristomie, almost as wide as the peristomie. The ovicell is globular, salient, smooth; it is hyperstomial and opens by a very large orifice above the apertura and opposite the spiramen. Two small triangular avicularia are placed symmetrically on each side of the apertura.

*Measurements*.—Apertura (without rimule)  $\left\{ \begin{array}{l} ha=0.05 \text{ mm.} \\ la=0.07 \text{ mm.} \end{array} \right.$

Zoecia  $\left\{ \begin{array}{l} Lz=0.35-0.50 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array} \right.$

*Variations*.—The young zoecia have no superior arch and are deprived of spiramen. On the adult zoecia when the superior arch is not formed the lateral lips of the peristomie limit a rimule-spiramen. The lateral areolae are little visible because of the very large

convexity of the frontal; they are quite apparent when the preparation is properly inclined.

The spiramen is little visible in perspective because it is in a plane almost perpendicular to the zoöcial plane.

*Occurrence*.—Lower Jacksonian: Jackson, Mississippi (rare).

*Type*.—Cat. No. 62603, U.S.N.M.

#### Genus HASWELLIA Busk, 1884.

1884. *Haswellia* BUSK, Report on the Polyzoa collected by H. M. S. *Challenger*, pt. 1, p. 171.

The apertura has its proximal border notched by a very wide rimule not separated from the anter. The frontal is a very thick tremocyst. The spiramen is a small salient tube. The zoarium is cylindrical.

*Genotype*.—*Haswellia* (*Myriozoum*) *australiensis* Haswell, 1880.

*Range*.—Tongrian-Recent.

#### SEMIHASWELLIA, new genus.

The zoöcia are disposed only on one side of the zoarium; the dorsal bears only avicularia. The frontal and the dorsal are of the same nature and are formed of a tremocyst with sulci.

*Genotype*.—*Porina proboscidea* Waters, 1888. *Range*: Jacksonian-Recent.

This new genus is zoarial; no distinct zoöcial function separates it from *Haswellia*. Nevertheless it has some important zoarial functions susceptible of giving generic characters; the very constant presence of small dorsal avicularia seems to be a very good character. The recent specimens are extremely rare and it is still not possible to study them in detail. Species of both *Haswellia* and *Semihawellia* occur in the Jacksonian of the Southern States.

#### Genus GIGANTOPORA Ridley, 1881.

1881. *Gigantopora* RIDLEY, Zoological collections made during survey of H. M. S. *Alert*. Proceedings Zoological Society London, p. 47.

The apertura bears a rimule. The frontal is an olocyst. The spiramen is inconstant; it is almost as large as the apertura.

*Genotype*.—*Gigantopora lynchoides* Ridley, 1881.

*Range*.—Jacksonian-Recent.

#### Genus GEPHYROPHORA Busk, 1884.

1884. *Gephyrophora* BUSK, Report on the Polyzoa collected by H. M. S. *Challenger*, pt. 1, p. 67.

The apertura nears a proximal rimule. The frontal is a tremocyst.

*Genotype*.—*Gephyrophora polymorpha* Busk, 1884.

*Range*.—Tongrian-Recent.

**Genus TESSARADOMA Norman, 1868.**

1868. *Tessaradoma* NORMAN, Report 38th Meeting, British Association for the Advancement of Science, p. 309.

The apertura is provided with cardelles. The frontal is surrounded by areolae and covered by a pleurocyst. The spiramen opens at the level of the operculum. The operculum in opening closes the spiramen.

*Genotype*.—*Tessaradoma* (*Pustulopora*) *gracile* Sars, 1850.

*Range*.—Jacksonian-Recent.

In spite of Jullien's observations, the exact nature of the spiramen is still doubtful; its place and its function are not yet elucidated. Several species referred to this genus occur in the American Jacksonian.

**TREMOTOICHOS, new genus.**

(*Trema*, opening; *toichos*, wall.)

The frontal and the dorsal are tremocysts with sulci. The spiramen opens interiorly at the level of the operculum; exteriorly it is distant from the peristomice and almost never placed on the median axis of the zoecia.

*Genotype*.—*Tremotoichos rectifurcatum*, new species. Jacksonian.

This genus possesses all the characters of *Semihawwellia*; the difference is little perceptible and consists solely in the place of the spiramen. As the latter does not appear to exercise the same physiological function (according to Jullien) as in *Semihawwellia*, we believe it necessary to create a new genus.

**TREMOTOICHOS RECTIFURCATUM, new species.**

Plate 6, fig. 1.

*Description*.—The zoarium is free, subcylindrical, branched almost at a right angle. The dorsal is very thick; deprived of avicularia and formed of a tremocyst with tubules and with sulci. The zoecia are indistinct; the frontal is a tremocyst with sulci placed on an olocyst with very small perforations. The peristome is salient, perpendicular to the zoarial plane, thick, and provided with a small proximal avicularium; the peristomice is orbicular. The spiramen is a pore of the frontal placed on the right or left of the median axis and distant from the peristomice.

*Measurements*.—Peristomice  $\left\{ \begin{array}{l} hpe = 0.10 \text{ mm.} \\ lpe = 0.10 \text{ mm.} \end{array} \right.$

Zoecia— $Lz = 0.70 \text{ mm.}$

*Variations*.—The spiramen is not always apparent; it is confused with the tremopores. The peristome of the young zoecia is thin.

The sulci are not always apparent on the dorsal. The peristome may bear two small avicularia. The branches are sometimes quite close together.

*Occurrence*.—Middle Jacksonian: Wilmington, North Carolina (very common), near Lenuds Ferry, South Carolina (very common).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare).

*Type*.—Cat. No. 62606, U.S.N.M.

### Family HIPPOPODINIDAE Levinsen, 1909.

The frontal is calcified. The ovicell is endozoöcial.

We have extended the meaning of Levinsen's definition since we include in this family all the species provided with an endozoöcial ovicell. Evidently we can not affirm that they all have the same larva; but the identity of the ovicell implies that the larvae are at least closely related.

The known genera of this family, all represented in American strata, are as follows:

*Cheilopora* Levinsen, 1909.

*Hippopodina* Levinsen, 1909.

*Metrarabdotos* Canu, 1914.

*Watersipora* Neviani, 1895.

### Genus CHEILOPORA Levinsen, 1909.

1909. *Cheilopora* LEVINSEN, Morphological and Systematic Studies on the Chelostomatous Bryozoa, p. 353.

The frontal is a tremocyst with pores in quincunx not separable from the olocyst subjacent and perforated with very small corresponding pores. Two dietellae. "The distal wall has no expansion partly separating the ovicell from the zoöcium; multiporous septulae; peristome present in the form of a liplike projection." (Levinson, 1909.)

*Genotype*.—*Cheilopora* (*Lepralia*) *sincera* Smitt, 1867.

*Range*.—Aquia—Recent.

*Cheilopora* (*Lepralia*) *labiosa* Ulrich, 1901, and nine new species represent this genus in the early Tertiary of America.

### Genus HIPPOPODINA Levinsen, 1909.

1909. *Hippopodina* LEVINSEN, Morphological and Systematic Studies on the Chelostomatous Bryozoa, p. 353.

The apertura is provided with two cardelles. The frontal is a tremocyst placed on a finely perforated and very thin olocyst. The ovicell is endozoöcial. "The horizontal part of the distal wall is

continued into an expansion which forms a partial partition between the ovicell and the zoecium; uniporous septulae; no peristome." (Levensen, 1909.)

*Genotype*.—*Hippopodina* (*Lepralia*) *feegensis* Busk, 1884.

*Range*.—Jacksonian—Recent.

#### HIPPOPODINA VIBRACULIFERA, new species.

Plate 5, fig. 8.

*Description*.—The zoarium is free, bilamellar; the two lamellae back to back are easily separated. The zoecia are elongated, large, hexagonal; the frontal is convex and formed of a tremocyst with very numerous pores placed on a very finely perforated olocyst from which it is separable. The apertura is formed of a very large orbicular anter and of a narrower poster with proximal lip straight and denticulated; the vestibular arch is clearly visible. The endozoecial ovicell is immense and takes the place of a zoecium; it is convex and perforated with tremopores; the apertura of the ovarian zoecia is much larger. Two auriculate vibracula are placed symmetrically on the distal part of the zoecia.

*Measurements*.—Apertura of ordinary zoecia  $\left\{ \begin{array}{l} \lambda a = 0.25 \text{ mm.} \\ \lambda a = 0.28 \text{ mm.} \end{array} \right.$   
 Apertura of ovarian zoecia  $\left\{ \begin{array}{l} \lambda a = 0.25 \text{ mm.} \\ \lambda a = 0.35 \text{ mm.} \end{array} \right.$   
 Zoecia  $\left\{ \begin{array}{l} Lz = 0.90-1.10 \text{ mm.} \\ lz = 0.80-1.00 \text{ mm.} \end{array} \right.$

*Occurrence*.—Middle Jacksonian: Wilmington, North Carolina (common).

Upper Jacksonian (Ocala limestone): Old factory, 1½ miles above Bainbridge, Georgia (rare).

*Type*.—Cat No. 62604, U.S.N.M.

#### Genus METRARABDOTOS Canu, 1914.

1914. *Metrarabdotos* CANU, Les Bryozoaires fossiles Sud-Ouest France. Bulletin Societe Geologique France, ser. 3, vol. 14, p. 472.

The ovicell is endozoecial. The apertura is semilunar, with a rimule and lyrule. The frontal is surrounded with lateral areolae and formed of an olocyst surmounted by a pleurocyst.

*Genotype*.—*Metrarabdotos* (*Eschara*) *moniliferum* Milne-Edwards, 1838.

*Range*.—Priabonian—Astian.

The genotype is a common and characteristic Vicksburgian fossil of the Southern States.

Genus *WATERSIPORA* Neviani, 1895.

895. *Watersipora* NEVIANI, Briozoi neozoi di alcune località d' Italia, Bolletino della Società Romana per gli Studi Zoologici, pt. 2, vol. 4, p. 231.

The operculum is membranous or very slightly chitinous on the borders; it exhibits a chitinous axial band of a brown color marking out from the rest of the operculum two lateral spaces which are clearer and which correspond to the two powerful cardelles borne by the zoecial orifice. The frontal is a tremocyst.

*Genotype*.—*Watersipora* (*Lepralia*) *cucullata* (Busk, 1853), variety *labiosa* Calvet, 1903.

*Range*.—Helvetian—Recent. One new species in the Upper Jacksonian.

## Family TUBUCELLARIIDAE Busk, 1884.

The zoecia have no spines; their frontal is formed of long tremocystal tubules surmounting a thin perforated olocyst. The septulae are numerous, scattered, and multiporous. The ovicell is peristomiale, being formed by a great expansion of the peristomie which is always very long. The frontal bears an ascopore opening into the compensatrix.

The zoarium is free, unilamellar, bilamellar, or cylindrical. It is often articulated and radicellated. The articulated zoarium generally lives among algae, the mobility and flexibility of which it must share.

*Key to genera.*

Zoarium articulated. No avicularia.....*Tubucellaria*.  
 Zoarium, fixed, bilamellar. Avicularia very rare.....*Tubucella*.  
 Zoarium unilamellar. Avicularia on each zoecium.....*Tubiporella*.

Genus *TUBUCELLARIA* D'Orbigny, 1852.

1852. *Tubucellaria* D'ORBIGNY, Paleontologie française, Terrain Cretace, vol. 5, p. 335.

The zoarium is articulated and radicellated. The operculum is simple and separable. No vestibular arch, no avicularia.

*Genotype*.—*Tubucellaria* (*Cellaria*) *cereoides* Ellis and Solander, 1786.

*Range*.—Lutecian—Recent. Four new species in the Eocene and Oligocene of America.

*TUBUCELLA*, new genus or subgenus.

The zoarium is free, bilamellar, firmly attached, rigid. The avicularia are very rare. The peristomiale is equal to the frontal.

*Genotype*.—*Tubucella* (*Eschara*) *mamillaris* Milne-Edwards, 1836.

*Range*.—Lutecian—Jacksonian.

**TUBUCELLA MONILIFERA, new species.**

Plate 5, fig. 9.

**Description.**—The zoarium is free; the two lamellae are placed back to back and intimately joined; the fronds are broad, compressed, distorted, and branching. The zoecia are much elongated, fusiform, little distinct, surrounded by a collar of large pores; the frontal and the peristomiale are of equal length, separated by the ascopore and perforated with small hexagonal pores. The peristome is salient, thick, oblique. The avicularia are very rare, large, transverse, elliptical, with two denticles for a pivot.

**Measurements.**—Zoecia  $\left\{ \begin{array}{l} Lz=0.90-1.00 \text{ mm.} \\ lz=0.32 \text{ mm} \end{array} \right.$

**Variations.**—The zoecia are very constant in their exterior aspect. The larger pores surround the peristomiale and are three times larger than the others.

Certain fronds bear some zoecia, closed, not by the olocyst, but by the tremocyst, the tubules of which have encroached upon the peristome. The physiological function of these zoecia is unknown.

The avicularia are scattered, are very large, and form a very large frontal, the origin of which is one of the lateral pores of the peristomiale.

**Occurrence.**—Middle Jacksonian: Wilmington, North Carolina (common).

Eutaw Springs, South Carolina (rare).

**Type.**—Cat. No. 62605, N.S.N.M.

**Genus TUBIPORELLA Levinsen, 1909.**

1909. *Tubiporella* LEVINSEN, Morphological and Systematic Studies on the Chelostomatous Bryozoa, p. 204.

A membranous opercular valve. A vestibular arch; each zoecium with one or two avicularia at the height of the ascopore. The colony occurs as a free foliaceous expansion, with a single layer of zoecia (Levinsen).

**Genotype.**—*Tubiporella* (*Lepralia*) *magnirostris* MacGillivray, 1882.

**Range.**—Miocene-Recent.

**Family CATENICELLIDAE Busk, 1852.****CATENICELLA SUBSEPTENTRIONALIS, new species.**

Plate 5, fig. 5.

The Catenicellidae are bryozoa peculiar to the southern hemisphere. They abound in the recent seas off Australia, and their fossil

forms are frequent in the same region. However, Waters discovered in the Priabonian of the Vicentin<sup>1</sup> two species having some affinities with this family; namely *Catenicella septentrionalis* Waters 1891, and *C. continua* Waters, 1891. According to Waters<sup>2</sup> the latter species is a *Vittaticella* and the first belongs to a new genus.

The single and unique fragment found in America is very close to *Catenicella septentrionalis* Waters, 1891. It differs from it in its somewhat larger micrometric dimensions, more closely arranged frontal pores, and in the presence of a small, oral avicularium.

*Occurrence*.—Vicksburgian; Salt Mountain, 5 miles south of Jackson, Alabama. (Very rare.)

*Type*.—Cat. No. 62601, U.S.N.M.

### Family ADEONIDAE Jullien, 1903.

The zoëcia are provided with a compensatrix, but are devoid of spines and oral glands. The areolae are always closed and excavated out of the wall substance itself. The frontal is composed of an olocyst covered by a very thick pleurocyst. The operculum opens at the bottom of a peristomie. The female zoëcia are of the kind termed gonœcia and are often larger than the others; they contain an ovicell sac in which the embryo is developed. The septulae are numerous, placed in linear rows, arranged to correspond to the areolae. The avicularia are frontal or interzoëcial; the latter have no pivot.

### Genus MENISCOPIRA Gregory, 1893.

1893. *Meniscopora* GREGORY, British Palaeogene Bryozoa, Transactions Zoological Society of London, p. 250.

The zoëcia are trimorphic. The normal axial zoëcia have an external aperture straighter than that of the marginal zoëcia; the aperture is formed of a semilunar anterior and of a very concave posterior part. The gonœcia are larger than the ordinary zoëcia and their aperture is of different form. The peristomie is of slight depth. Interzoëcial avicularia are rare. Certain lateral areolae are transformed into small frontal avicularia.

*Genotype*.—*Meniscopora bigibbera* Gregory, 1892.

*Range*.—Thanetian–Helvetian.

*Meniscopora (Lepralia) subplana* Ulrich, 1901, from the Lower Eocene (Aquia) of Maryland and one new species from the Vicksburgian of Mississippi represent this genus in the United States.

<sup>1</sup> North Italian Bryozoa, Quarterly Journal Geological Society London, vol. 47, 1891, p. 5, pl. 1, figs. 1–8.

<sup>2</sup> Marine Fauna Zanzibar, Proceedings Zoological Society London, 1913, p. 483.

**Genus BRACEBRIDGIA MacGillivray, 1886.**

1886. *Bracebridgia* MACGILLIVRAY, Description of new or little known Polyzoa, Transactions Royal Society Victoria, p. 8.

MacGillivray's original description is as follows:

Zoarium bilaminar, erect. Apertura subcircular, straighter below, with an internal denticle; peristome thickened, smooth, or with a small apiculate mucro; frequently in the fossils, but rarely in recent specimens, a triangular avicularium immediately below the lower lip; lateral avicularia on the free edges of the zoarium.

The gonœcia are larger than the usual zoœcia. The frontal is partially or totally covered by a pleurocyst which is more or less confluent with the subjacent olocyst.

*Genotype*.—*Bracebridgia (Porella) emendata* Waters, 1881.

*Range*.—Jacksonian—Recent.

One new species from the Middle Jacksonian of Georgia and a new variety of *Bracebridgia polymorpha* Reuss, 1864 occur in the Lower Tertiary of the United States.

**Genus ADEONA (Lamouroux, 1816) Levensen, 1909.**

1909. *Adeona* LEVENSEN (LAMOUROUX, 1816), Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 283.

The frontal is perforated by an ascopore opening into the compensatrix. The operculum is semilunar. The gonœcia are distinct and larger than the ordinary zoœcia.

*Genotype*.—*Adeona (Cellepora) heckeli* Reuss, 1847.

**Genus ADEONELLA (Busk, 1884) Waters, 1888.**

1884. *Adeonella* BUSK, Report Voyage Challenger, Zoology, vol. 10, pt. 30, p. 183.

Zoarium erect, very variously branched or lobate, attached by a contracted base, or pedicle, often containing radial fibers and affixed usually on a more or less flexible support (Busk). The zoœcia without such median ascopores; the proximal part of the secondary aperture, which appears sooner or later, is transformed by a coalescence of two calcareous processes into a pore, which leads into the space between the primary and secondary aperture. (Levensen, Waters.)

The peristomie is perforated by a spiramen. The aperture bears a concave lower lip which is the opening of the compensatrix; the operculum is at the bottom of the peristomie and below the spiramen.

*Genotypes*.—*Adeonella polymorpha* Busk, 1884, and *Adeonella (Eschara) polystomella* Reuss, 1847.

*Range*.—Jacksonian—Recent.

## ADEONELLA FOLLICULATA, new species.

Plate 6, fig. 3.

*Description.*—The zoarium is bilamellar with two lamellae back to back and separable; the fronds are lobed, very thin and fragile. The zoecia are very long, distinct, separated by a furrow, little convex, bordered with numerous parietal areolae (10–12 pairs). The peristomie is short, somewhat projecting exteriorly and is perforated by a spiramen; the peristomice is semilunar with a convex lower lip; the aperture (interior) presents a proximal concave border. The gonœcia are larger (0.30 mm.) than the other zoecia; their external aperture is greater ( $la=0.10$  mm.) and the spiramen is more removed from the aperture. There is a very small, simple avicularium on the peristomie.

*Measurements.*—Lateral zoecia  $\left\{ \begin{array}{l} Lz=0.65-0.75 \text{ mm.} \\ lz=0.20-0.25 \text{ mm.} \end{array} \right.$

Axial zoecia  $\left\{ \begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{array} \right.$

Gonœcia  $\left\{ \begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array} \right.$

Peristomice of zoecia  $\left\{ \begin{array}{l} hp=0.04 \text{ mm.} \\ lp=0.07 \text{ mm.} \end{array} \right.$

Peristomice of gonœcia  $\left\{ \begin{array}{l} hp=0.04 \text{ mm.} \\ lp=0.10 \text{ mm.} \end{array} \right.$

*Occurrence.*—Middle Jacksonian (Castle Hayne beds): Wilmington, North Carolina (common).

*Type.*—Cat. No. 62608, U.S.N.M.

## Genus ADEONELLOPSIS MacGillivray, 1886.

1886. *Adeonellopsis* MACGILLIVRAY, Description of New Polyzoa, pt. 2. Transactions Royal Society Victoria, p. 7.

The zoecia provided in the central line with one or several ascopores. (Levinsen.)

The ascopores are grouped at the base of a cribriform area. Inter-zoecial avicularia and gonœcia are present.

*Genotype.*—*Adeonellopsis foliacea* MacGillivray, 1886.

*Range.*—Wilcoxian–Recent.

Seven new species ranging from the Wilcoxian to the Vicksburgian have been determined in the Eocene of the United States.

## PHYLACTELLIDAE, new family.

The ovicell is recumbent; its orifice is very large and closed by a special operculum. "The larvae are large and are more fully developed within the ovicell than is usual; the corona and cilia are very distinct."

In 1900 Waters<sup>1</sup> discovered the larva of *Phylactella*. It is quite distinct from all others in its form and its large dimensions, evidently characterizing a special family.

The special ovicell which Waters called recumbent is placed on the distal part of the zoecium itself, between the apertura and the distal zoecium. Viewed laterally it appears attached like a sack on the back of a porter. Evidently it is also more or less supported on the distal zoecium, but frequently it is completely separated from it. In its form, position, and large opening it is eminently adapted to the size of the larvae.

### Genus PHYLACTELLA Hincks, 1880.

1880. *Phylactella* HINCKS, British Marine Polyzoa, p. 356.

The apertura is more or less circular; it bears either a lyrule or some cardelles. The thick band of the operculum is at a small distance from the edge. The apertura is surrounded by a peristomie more or less funnel shaped. The peristome is interrupted distally and replaced by a small tongue. The frontal is a tremocyst with very fine pores. No spines.

*Genotype*.—*Phylactella labrosa* Busk, 1852.

*Range*.—Jacksonian-Recent.

In addition to the one here described three new species have been determined in the Early Tertiary rocks of the Carolinas and Alabama.

### PHYLACTELLA INFUNDIBULUM, new species.

Plate 6, fig. 2.

*Description*.—The zoarium incrusts other bryozoa. The zoecia are large, distinct, elongated, oval; the frontal is quite convex; it is formed of a tremocyst with very small pores separated from each other by fine granules. The apertura is formed of a large semicircular anter, separated by two small cardelles from a very concave poster; the peristome is long, tubular, depressed in front, and interrupted behind by a wide distal tongue; the peristomie forms a sort of funnel around the apertura.. The ovicell is large, salient, globular, finely porous and granular; it is hyperstomial, recumbent, and opens into the peristomie.

*Measurements*.—Apertura  $\left\{ \begin{array}{l} ha=0.16 \text{ mm.} \\ la=0.16-0.17 \text{ mm.} \end{array} \right.$   
 Zoecia  $\left\{ \begin{array}{l} Lz=1.25 \text{ mm.} \\ lz=0.72 \text{ mm.} \end{array} \right.$

This superb species is, unfortunately, quite rare.

<sup>1</sup> 1900. Waters, Bryozoa from Franz Josef Land. Journal Linnean Society Zoology, London, vol. 28, p. 90, pl. 12 figs. 3, 4.

*Occurrence*.—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Type*.—Cat. No. 62607, U.S.N.M.

**PERIGASTRELLA, new genus.**

(*Peri*, around; *gaster*, stomach.)

The apertura is semicircular. The thick band of the operculum is on the border. The frontal is surrounded by one or two rows of small areolae; it is formed of an olocyst supporting a smooth or finely granular pleurocyst. Spines.

*Genotype*.—*Perigastrella (Lepralia) labiata* Böeck, 1861.

*Range*.—Lutecian—Recent.

This genus is abundantly represented in the Claibornian, Jacksonian, and Vicksburgian of the Southern States, *Perigastrella (Cellepora) cycloris* Gabb and Horn, 1862, and 13 new species being known.

**PERIGASTRELLA OVOIDEA, new species.**

Plate 6, fig. 8.

*Description*.—The zoarium incrusts shells. The zoecia are distinct, elongated, large, ovoid; the frontal is very convex, bordered by three small areolar pores, and formed of a very finely granular pleurocyst, almost smooth. The apertura, almost invisible exteriorly, is trapezoidal and oblique; the peristomie is deep; the peristome is very oblique and bears 6–8 spines; it is sometimes interrupted in front, but more often it bears a salient mucro, oblique or erect, hiding more or less the apertura; there is small lyrule in the apertura. The ovicell is small, salient, globular, almost entirely detached from the distal zoecium; it is hyperstomial and recumbent: its frontal is finely granular, like the zoecia. The ancestrula is very small, but identical in form with the other zoecia.

*Measurements*.—Apertura  $\begin{cases} ha=0.05 \text{ mm.} \\ la=0.06-0.10 \text{ mm.} \end{cases}$   
 Zoecia  $\begin{cases} Lz=0.75-0.80 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{cases}$

*Affinities*.—This beautiful species is quite recognizable by its very large zoecial convexity. It differs from *Perigastrella semierecta* Koschinsky, 1885, in the presence of spines and in its somewhat larger dimensions.

*Occurrence*.—Middle Jacksonian: Eutaw Springs, South Carolina (common).

Upper Jacksonian: Railroad wharf at Bainbridge, Georgia (common).

*Type*.—Cat. No. 62613, U.S.N.M.

**Genus HEMICYCLOPORA Norman, 1909.**

1909. *Hemicyclopora* NORMAN, Polyzoa of Madeira and neighboring islands.  
Journal Linnean Society, London, Zoology, vol. 30, p. 308.

The ovicell is recumbent. The apertura is provided with very low cardelles and formed of a large anter and of a small concave poster. The frontal is smooth and formed of an olocyst. Spines.

*Genotype*.—*Hemicyclopora* (*Lepralia*) *polita* Hincks, 1880.

*Range*.—Helvetian—Recent.

**HEMICYCLOPORA PARAJUNCTA, new species.**

Plate 6, fig. 6.

*Description*.—The zoarium incrusts shells. The zoœcia are distinct, somewhat elongated, ogival; the frontal is somewhat convex and absolutely smooth. The apertura is oblique, suborbicular; the peristome bears 8 distal spines and a proximal small mucronoid lip. The ovicell is globular, very salient, smooth, very little joined to the distal zoœcium; it is recumbent, hyperstomial.

*Measurements*.—Apertura  $\left\{ \begin{array}{l} ha=0.10 \text{ mm.} \\ la=0.09 \text{ mm.} \end{array} \right.$   
Zoœcia  $\left\{ \begin{array}{l} Lz=0.50-0.55 \text{ mm.} \\ lz=0.40-0.55 \text{ mm.} \end{array} \right.$

*Affinities*.—This species offers the exterior aspect of a *Perigastrella* with very small areolae, which generally appear smooth.

*Occurrence*.—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common).

*Type*.—Cat. No. 62610, U.S.N.M.

**Genus MASTIGOPHORA Hincks, 1880.**

1880. *Mastigophora* HINCKS, British Marine Polyzoa, p. 278.

The ovicell is small and recumbent. The apertura is semilunar; its proximal border is straight and bears a rimule elongated and rounded. The frontal is a tremocyst with small pores placed on an olocyst. Vibracula.

*Genotypes*.—*Mastigophora hyndmanni* Johnson, 1847, and *Mastigophora* (*Flustra*) *dutertrei* Savigny-Audouin, 1826.

*Range*.—Lutecian—Recent.

Both of the genotypes of this well-marked genus occur in the Jacksonian and Vicksburgian strata of the Southern States.

**SCHIZOBATHYSELLA, new genus.**

(*Schizos*, slit, and *bathys*, deep, referring to the position of the apertura.)

The apertura presents on its straight proximal border a small linear rimule. The ovicell is recumbent and opens widely above the apertura. The frontal is a tremocyst. The peristomie is greatly expanded and is interrupted in front by an immense incomplete spiramen. The avicularium is vibraculoid.

*Genotype*.—*Schizobathysella saccifera*, new species. Jacksonian.

This genus differs from *Mastigophora* only in the nature of the peristome, which is much more salient and interrupted in front by a pseudospiramen.

It differs from *Gigantopora* Ridley, provided also with a spiramen, in the different form of the operculum and in its smooth frontal.

**SCHIZOBATHYSELLA SACCIFERA, new species.**

Plate 6, fig. 7.

*Description*.—The zoarium incrusts shells. The zoecia are distinct, elongated, irregularly elliptical; the frontal is convex and formed of a tremocyst with small pores. The apertura is semilunar; it bears on its straight proximal border a small linear rimule; the peristome is much developed into two large lateral lips circumscribing a sort of incomplete and very large spiramen. The ovicell is hyperstomial and recumbent; it forms a sort of small, punctured sack placed on the bottom of the zoecium. A small vibraculoid avicularium is developed laterally near the apertura.

*Measurements*.—Apertura  $\lambda a = 0.08$  mm.  
 $\lambda a = 0.10$  mm.

Zoecia  $Lz = 0.60-0.70$  mm.  
 $lz = 0.30-0.40$  mm.

*Variations*.—The peristome is quite variable. The tremopores are often obliterated by fossilization. The ovicell is truly recumbent or partially supported on the distal zoecium. To accommodate so great a peristomial complexity it is probable that the tentacles were very long and fine.

*Occurrence*.—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Type*.—Cat. No. 62611, U.S.N.M.

**Genus LAGENIPORA Hincks, 1877.**

1877. *Lagenipora* HINCKS, British Polyzoa, Annals Magazine Natural History (4), vol. 20, p. 215.

Colonies consisting of a number of cells immersed in a common calcareous crust. Zoecia recumbent, contiguous, lageniform; oral extremity free, tubular, with a terminal orbicular orifice. (Hincks)

*Genotype*.—*Lagenipora socialis* Hincks, 1880.

*Range*.—Jacksonian-Recent.

## Family CELLEPORIDAE Busk, 1852.

The ovicell is recumbent. The budding is double; terminal and superficial. The zoecia are more or less erect and cumulate.

## Genus SCHISMOPORA MacGillivray, 1888.

1888. *Schismopora* MACGILLIVRAY, Bryozoa in McCoy's Prodrum of the Zoology of Victoria, vol. 2, dec. 17, p. 253.

The ovicell is perforated. The frontal is smooth. The apertura bears a proximal rimule. No spines.

*Genotypes*.—*Schismopora* (*Cellepora*) *coronopus* S. Wood, 1850, and *Schismopora* (*Cellepora*) *pumicosa* Busk, 1854.

*Range*.—Jacksonian—Recent.

Three new species of *Schismopora* occur in the Jacksonian of the Southern States.

## Genus OSTMOSIA Jullien, 1888.

1888. *Osthimosia* JULLIEN, Mission scientifique du Cap Horn, No. 6, Zoologie, p. 64.

The ovicell is not perforated. The frontal is surrounded by areolae. The apertura bears a proximal rimule. There are no spines.

*Selected genotype*.—*Osthimosia* (*Cellepora*) *eationensis* Busk, 1884.

*Range*.—Jacksonian—Recent.

Jullien's genotype was *Osthimosia eveva* Jullien, 1888.

*Osthimosia* (*Reptocelleporina*) *glomerata* Gabb and Horn, 1862, from the Jacksonian and Vicksburgian, is the only American representative of this genus known.

## Genus COSTAZZIA Neviani, 1895.

1895. *Costazzia* NEVIANI, Briozoi neozoi di alcune localita d'Italia, Bollettino Societa Romana per gli Studi Zoologici, pt. 2, vol. 4, p. 235 (sep. 11).

The ovicell at the side of the peristome has a flat area and pores around the border. (Waters.)

I zoeci, acervulati, hanno la frontal molto rigonfia, variamente perforata ed ornata da leggere costule; l'apertura zoeciale subtrigona con labbro calloso; grandi aviculari scafoidi sono sparsi fra i zoeci. (Neviani.)

*Genotype*.—*Costazzia* (*Cellepora*) *costazzi* Savigny-Audouin, 1828.

*Range*.—Vicksburgian—Recent.

## Genus HOLOPORELLA Waters, 1909.

1909. *Holoporella* WATERS, Reports on the Marine Biology of the Sudanese Red Sea, etc., pt. 12. The Bryozoa. Journal Linnean Society, London, vol. 31, p. 159.

The lower lip of the aperture is more or less straight; the operculum has the muscles attached near the border, sometimes with a ridge (for the attachment of the tentacular sheath) running inwards. The ovicell is a widely open cap. There are usually oral and vicarious (interzoecial) avicularia, and the mandible of one of the two usually has a small projection from the base or columella. (Waters, 1909.) Spines.

*Genotype*.—*Holoporella* (*Cellepora*) *descostilsi* Savigny-Audouin, 1828.

*Range*.—Claibornian—Recent.

The genus *Holoporella* is represented in the Claibornian, Jacksonian, and Vicksburgian of the Southern States by 12 new species.

## ACANTHIONELLA, new genus.

(*Akanthos*, spine.)

The apertura is oval and bears a long lyrule. The frontal is a very thick olocyst, in which are lodged some avicularia. The ovicell is hyperstomial. It is lodged in the thickening of the frontal of the distal zoecia. It opens into the peristomie.

*Genotype*.—*Acanthionella* (*Escharifora*) *typica* Gabb and Horn, 1862.

*Range*.—Maastrichtian—Claibornian.

This genus differs from *Kleidionella* in the presence of a lyrule and the rarity of cumulate zoecia.

## KLEIDIONELLA, new genus.

(*Kleidion*, small key, referring to the form of the apertura.)

The apertura is oval. The frontal is a very thick olocyst. The ovicell is hyperstomial and lodged in the olocyst of the distal zoecia. It opens into the peristomie. There are some small and some large interzoecial avicularia. No lyrule.

*Genotype*.—*Kleidionella grandis*, new species.

*Range*.—Claibornian—Vicksburgian.

The abundance of cumulate zoecia and the absence of lyrule distinguishes this genus from the preceding one, *Acanthionella*.

## KLEIDIONELLA GRANDIS, new species.

Plate 6, figs. 9, 10.

*Description*.—The zoarium is very large, compressed, formed of bifurcated fronds almost in the same plane, attaining toward the

base 2 cm. 5 mm. in width. The zoecia are disposed in two groups, back to back and inseparable. The axial zoecia back to back are oriented; all the other zoecia are cumulate. The superficial zoecia are distinct, urceolate, little raised, very oblique; the frontal is quite convex, smooth, bearing 0-3 improminent avicularia with pivot; the frontal is formed of a very thick olocyst. The apertura is oval, deeply imbedded at the base of a peristomie; the peristomie is irregular, suborbicular. The deep zoecia have a flat frontal; their avicularia are prominent between the superficial zoecia. The inter-zoecial avicularia are distinct, elliptical, of the size of zoecia; they have a pivot; their orifice is like the beak of a duck; the passage of the reflexor muscles of the operculum is indicated by the very small perforations on the inferior cavity; the beak is salient above the zoarium. The incomplete zoecia are quite numerous. On many zoaria there are some distinct groups of large zoecia and of small zoecia.

*Measurements.*—Apertura (interior)  $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$   
 Zoecia  $\begin{cases} Lz=0.60 \text{ mm.} \\ lz=0.30-0.35 \text{ mm.} \end{cases}$

*Variations.*—Following the rule, the variations of these Cellepores are quite great, but the species is always rather easy to determine by its zoarial size.

*Occurrence.*—Lower Jacksonian: Jackson, Mississippi (common).

Middle Jacksonian: Wilmington, North Carolina (common);  $3\frac{1}{2}$  miles south of Perry, Georgia (common).

Upper Jacksonian: Cocoa post office, Choctaw County, Alabama (very common).

Vicksburgian:  $7\frac{1}{2}$  miles from Bladen Springs, Alabama (rare); Red Bluff, Wayne County, Mississippi (rare).

*Type.*—Cat. No. 62613, U.S.N.M.

### Family CONESCHARELLINIDAE Levinsen, 1909.

The zoecia are erect; the apertura is terminal. The gemmation is always and uniquely lateral. The ovicell is hyperstomial and recumbent. There is a zoecial and a zoarial hydrostatic system.

This is a very mysterious group which has given the zoologists much trouble. Only Maplestone in 1910<sup>1</sup> has given some details on the zoarial life.

Almost all our specimens belong to a new American genus *Schizorthosecos*.

<sup>1</sup> 1910. Maplestone. On the Growth and Habits of Biporae, Proceedings Royal Society Victoria, vol. 28.

## Genus FEDORA Jullien, 1882.

1882. *Fedora* JULLIEN, Dragages du Travailleur, Bulletin Société Zoologique France, vol. 7, p. 17.

According to Jullien this genus has the following characters:

Zoecia subhexagonal with circular orifice, thick but not salient, notched on its posterior fourth where it is thin; finally placed a little above the center of the zoecium, of which it occupies about a third of the diameter; the ovicell nonsalient, indicated exteriorly by a smooth stripe forming an obtuse angle, of which the summit is turned toward the orifice. Avicularia not constant, situated on the sides and outside of the orifice.

*Genotype*.—*Fedora edwardsi* Jullien, 1882.

*Range*.—Lutecian–Recent. One American species.

## Genus STICHOPORINA Stoliczka, 1862.

1862. *Stichoporina* STOLICZKA, Oligocène Bryozoen von Latdorf in Bernburg. Sitzungsberichte der k. Akademie der Wissenschaften, Wien. vol. 45, Abth. 1, pp. 71–74, pls. 1–3.

The zoarium is cupuliform. The apertura is orbicular or elliptical with two cardelles; the apertura of the ovarian zoecia is larger and transverse. The avicularia have some vibraculoid mandibles.

*Genotype*.—*Stichoporina simplex* Koschincki, 1885.

*Range*.—Lutecian–Recent.

The only American species of *Stichoporina* differs in no appreciable manner from the well-known *S. protecta* Koschinski of the Lutecian and Priabonian. In North America the species has been found only in the Middle Jacksonian of North Carolina.

## SCHIZORTHOSSECOS, new genus.

(*Schizos*, slit; *orthos*, straight; *secos*, small habitation.)

The zoarium is cupuliform. The apertura is oval with a proximal rounded rimule. There are numerous interzoecial zoeciules capable of being transformed into avicularia, into radicular zoeciules, and into compensation zoeciules.

*Genotype*.—*Schizorthosecos* (*Orbitolites*) *interstitia* Lea, 1833.

*Range*.—Claibornian, Jacksonian.

This genus is exclusively American; it characterizes the Claibornian and the base of the Jacksonian where it is exterminated unexpectedly.

It differs from *Conescharellina* D'Orbigny and *Bipora* Whitelegge, 1887, in its distinct zoecia and in the absence of lunæcia. Moreover, we have not yet discovered the ovicells on the hundreds of specimens which we have at our disposal.

## SCHIZORHOSSEOS INTERSTITIA Lea, 1833.

Plate 6, figs. 4, 5.

1833. *Orbitolites interstitia* LEA, Contribution to Geology, Philadelphia, p. 191, pl. 6, fig. 204.

1862. *Lunulites interstitia* GABB and HORN, Monograph fossil Polyzoa Secondary and Tertiary formations North America, Journal Academy Natural Science, Philadelphia (2), vol. 5, p. 120.

1890. *Lunulites (Cupularia) interstitia* DE GREGORIA, Monographie Fauna Eocenique de Alabama, Annal. de Geologie et du Paleontologie, pts. 7, 8, p. 249, pl. 42, figs. 16-22.

*Description*.—The zoarium is cupuliform, little deep. The zoecia are distinct, tubular, erect, terminated by a narrowed peristomie. The apertura is placed at the base of the peristomie; in its rimule, it often has a flat lyrule; the peristomie is of the same form as the apertura. Between the peristomes, on the external surface, there are numerous zoeciules which are transformed according to their position into radicular zoeciules, into avicularia with pivot, or into compensation zoeciules. On the inner face each zoecium is indicated by a hexagon perforated with 6 to 10 large tremopores, which are the orifices of long tubules; some large avicularia with pivot surround the ancestrula.

*Occurrence*.—Claibornian: Claiborne, Alabama (very common), and many other localities.

Lower Jacksonian: Jackson, Mississippi (very common).

*Type*.—Cat. No. 62609, U.S.N.M.

## Genus ORBITULIPORA Stoliczka, 1862.

1862. *Orbitulipora* STOLICZKA, Oligocene Bryozoen von Latdorf in Bernburg, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 45, Abth., p. 90.

The apertura is orbicular. The frontal is a tremocyst. The zoarium is orbicular and formed of two lamellae with zoecia back to back.

*Genotype*.—*Orbitulipora (Cellepora) petiolus* Lonsdale, 1850.

*Range*.—Auversian-Tortonian.

## Genus BATOPORA Reuss, 1847.

1847. *Batopora* REUSS, Die fossilen Polyparien des Wiener Tertiarbeckens, Haldinger's naturwissenschaftliche, Abth. vol. 2, Wien, p. 78.

The apertura is orbicular. The frontal is a granular olocyst. The zoarium is conical, never hollow. The ancestrular zoecium is ornamented with radicular pores.

*Genotype*.—*Batopora rosula* Reuss, 1847.

*Range*.—Lutecian-Tortonian.

**Genus DILOTAXIS Reuss, 1867.**

1867. *Diplotaxis* REUSS, Ueber einige Bryozoen aus dem deutschen Unter-olligocan, Sitzungsberichte der k. Acad. der Wissenschaften, Wien, Abth. 1 p. 16.

The zoarium is discoidal and formed of two lamellae back to back. The zoecia of the external face are oriented toward the zoarial margins; the zoecia of the inner face are oriented toward the center. The apertura has a distal rimule.

*Genotype*.—*Diplotaxis placentula* Reuss, 1867. Latdorfian.

**Genus CONESCHARELLINA D'Orbigny, 1851.**

1851. *Conescharellina* D'ORBIGNY, Paleontologie française. Terrain Crétacé, vol. 5, p. 446.

The zoarium with lunæcia. The zoaria which have the form of a low cone or an arched disk only show a single layer of zoecia, while their inner cavity is occupied by numerous avicularia placed in horizontal layers. Ovicells may occur. (After Levinsen, 1909.) The apertura has a distal rimule.

*Genotype*.—*Conescharellina cancellata* Busk, 1852.

*Range*.—Miocene—Recent.

The lunæcia are the openings of special compensation zoeciules.

**Genus BIPORA Whitelegge, 1887.**

1887. *Bipora* WHITELEGGE, Notes on some Australian Polyzoa, Proceedings Linnean Society, New South Wales (2), vol. 2, p. 337.

The zoarium with lunæcia. The zoaria are plate-like or fan-shaped with two layers of zoecia; ovicells are not found. (After Levinsen, 1909.) The apertura has a proximal rimule.

*Genotype*.—*Bipora umbonata* Haswell, 1880. Recent.

**Genus FLABELLIPORA D'Orbigny, 1851.**

1851. *Flabellipora* D'ORBIGNY, Paleontologie française. Terrain Crétacé, vol. 5, p. 432.

The zoaria, which have no lunæcia, are plate-like, two-layered; no ovicells. (After Levinsen, 1909.) The apertura has a proximal rimule.

*Genotype*.—*Flabellipora elegans* D'Orbigny, 1851. Recent.

**Genus MAMILLOPORA Smitt, 1872.**

1872. *Mamillopora* SMITT, Floridian Bryozoa, pt. 1, Kongl. Svenska Vetenskaps Akademiens Handlingar, vol. 10, No. 11, p. 33.

The zoaria, which have no lunæcia, are plate-like, two-layered; no submedian cardelles. There are some avicularia between the zoecia. The ovicelled zoecia are much larger; their apertura is not transverse.

*Genotype*.—*Mamillopora cupula* Smitt, 1872. Recent. (Florida.)

## EXPLANATION OF PLATES.

### PLATE 1.

*Membraniporina benjamini*, new species (page 11).

FIG. 1. Surface of the incrusting zoarium  $\times 20$ , showing the elliptical zoecia and the incomplete small canal.

Upper Jacksonian, Rich Hill, Crawford County, Georgia.

Cat. No. 62569, U. S. N. M.

*Adenifera inarmata*, new species (page 12).

2. The usual aspect of the zoecia,  $\times 20$ .

Middle Jacksonian near Lenuds Ferry, South Carolina.

Cat. No. 62570, U. S. N. M.

*Otionella perforata*, new species (page 13).

3. Portion of the upper surface of an incomplete discoidal zoarium,  $\times 20$ .

4. The inner side of a fragment,  $\times 20$ .

Claibornian, Claiborne, Alabama.

Cat. No. 62571, U. S. N. M.

*Vibracellina capillaria*, new species (page 14).

5. The type-specimen,  $\times 20$ .

Claibornian, Moseley's Ferry, Caldwell County, Texas.

Cat. No. 62572, U. S. N. M.

*Hincksina jacksonica*, new species (page 15).

6. Surface of the bilamellar zoarium,  $\times 20$ ; with interzoecial avicularia little developed.

Middle Jacksonian, Rich Hill, Crawford County, Georgia.

Cat. No. 62573, U. S. N. M.

*Hincksina megavicularia*, new species (page 16).

7. Portion of a zoarium,  $\times 20$ , illustrating especially the coalescing of opposite spines and the occurrence of large avicularia.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62574, U. S. N. M.

### PLATE 2.

*Ogivalina extimpora*, new species (page 17).

FIG. 1. Portion of a zoarium,  $\times 20$ , showing several ovicelled zoecia.

Middle Jacksonian, Rich Hill, Crawford County, Georgia.

Cat. No. 62575, U. S. N. M.

*Membrendocium pyriforme*, new species (page 17).

2. Surface of a specimen,  $\times 20$ , exhibiting the characteristic pyriform opesium.

Lower Jacksonian, Jackson, Mississippi.

Cat. No. 62576, U. S. N. M.

*Periporosella tantilla*, new species (page 19).

3. Exterior of a zoarium, with ovicells,  $\times 20$ .

4. An example with the surface abraded to show the dietellae,  $\times 20$ .

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62577, U. S. N. M.

*Membraniporidra porrecta*, new species (page 21).FIG. 5. Portion of a zoarium with ovicelled zoecia,  $\times 20$ .

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62578, U. S. N. M.

*Grammella transversa*, new species (page 20).

6. View of zoarial surface,
- $\times 20$
- , illustrating the zoecial characters and the transverse avicularia.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62579, U. S. N. M.

*Ellistina laza*, new species (page 19).

7. Photograph of the incrusting zoarium,
- $\times 20$
- , showing the thin mural rim, the avicularium, and the diatellae.

Middle Jacksonian. Wilmington, North Carolina.

Cat. No. 62580, U. S. N. M.

## PLATE 3.

*Stamenocella mediatriculifera*, new species (page 22).FIG. 1. Surface of the bilamellar zoarium,  $\times 20$ , exhibiting the elongate zoecia, broken ovicells, and median avicularia.Middle Jacksonian,  $3\frac{1}{4}$  miles southwest of Perry, Georgia.

Cat. No. 62581, U. S. N. M.

*Diplopholeos fusiforme*, new species (page 26).

2. Photograph of the incrusting zoarium,
- $\times 20$
- , showing the dimorphic opesia, the symmetrical lateral indentations, and the straight onychocellaria.

Upper Jacksonian, 4 miles below Bainbridge, Georgia.

Cat. No. 62582, U. S. N. M.

*Floridinella vicksburgica*, new species (page 28).

3. Two fragments natural size, and the surface,
- $\times 20$
- , of this hollow stemmed species.

Vicksburgian, 1 mile north of Monroeville, Alabama.

Cat. No. 62583, U. S. N. M.

*Dacryonella octonaria*, new species (page 28).

4. Well preserved surface of the incrusting zoarium,
- $\times 20$
- , exhibiting the improminent polypidial convexity, the large lateral indentations, and the numerous small avicularia.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62584, U. S. N. M.

*Aechmella flimargo*, new species (page 29).

5. View of the incrusting zoarium,
- $\times 20$
- , with the characteristic avicularia.

Upper Jacksonian, west bank of Sepulga River, Escambia County, Alabama.

Cat. No. 62585, U. S. N. M.

*Metracolpota robusta*, new species (page 35).

6. Portion of surface of the bilamellar zoarium,
- $\times 20$
- , with ovicelled zoecia.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62586, U. S. N. M.

## PLATE 4.

*Acanthocella erinacea*, new species (page 36).

- FIG. 1. Usual aspect of the zoecia,  $\times 20$ , with an ovicell developed on one.  
Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62587, U. S. N. M.

*Cribrendoecium tenuicostulatum*, new species (page 36).

2. Surface,  $\times 20$ , showing the very fine costules, transverse ovicells, and large interzoecial avicularia.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62588, U. S. N. M.

*Gastropella ventricosa*, new species (page 38).

3. Portion of the free cylindrical zoarium,  $\times 20$ , displaying the smooth frontal, lateral areolæ and the very large ascopore.

Midwayan, Mabelvale, near Little Rock, Arkansas.

Cat. No. 62589, U. S. N. M.

*Metroperiella biplanata*, new species (page 41).

4. Surface of the bilamellar zoarium,  $\times 20$ . The median avicularium is usually broken.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62590, U. S. N. M.

*Hippozugosella teges*, new species (page 42).

5. A fragmentary zoarium,  $\times 20$ .

Upper Jacksonian, Chipola River, east of Marianna, Florida.

Cat. No. 62591, U. S. N. M.

*Didymosella crassa*, new species (page 43).

6. Celluliferous surface of the unilamellar zoarium,  $\times 20$ , with the two large conspicuous pores to each zoecium.

Vicksburgian, west bank of Conecuh River, Escambia County, Alabama.

Cat. No. 62592, U. S. N. M.

*Stomachetosella crassicollis*, new species (page 45).

7. Surface of the bilamellar zoarium,  $\times 20$ , showing ovicelled zoecia.

Vicksburgian, west bank of Conecuh River, Escambia County, Alabama.

Cat. No. 62593, U. S. N. M.

*Enoplostomella defixa*, new species (page 46).

8. Portion of the cylindrical zoarium,  $\times 20$ .

Vicksburgian, 1 mile north of Monroeville, Alabama.

Cat. No. 62594, U. S. N. M.

*Schizemiella clatbornica*, new species (page 47).

9. View of surface of the bilamellar zoarium,  $\times 20$ , illustrating the indistinct zoecia and apertura with wide rimule.

Clairbornian, Clairborne, Alabama.

Cat. No. 62595, U. S. N. M.

*Metradolium dissimilis*, new species (page 48).

10. Part of the bilamellar zoarium,  $\times 20$ , with both ovicelled and non-ovicelled zoecia.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62596, U. S. N. M.

## PLATE 5.

*Letosella rostrifera*, new species (page 48).

FIG. 1. Portion of the narrow bilamellar zoarium,  $\times 20$ , showing the smooth frontal of the zoecia.

Vicksburgian, 1 mile north of Monroeville, Alabama.

Cat. No. 62597, U. S. N. M.

*Metrocrypta bucculenta*, new species (page 49).

2. A branched fragment,  $\times 20$ .

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62598, U. S. N. M.

*Ochetosella jacksonica*, new species (page 50).

3. View of well-preserved cylindrical zoarium,  $\times 20$ .

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62599, U. S. N. M.

*Plagiosmittia regularis*, new species (page 51).

4. Surface of the bilamellar zoarium,  $\times 20$ . All of the zoecia are ovicelled.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62600, U. S. N. M.

*Catenicella subseptentrionalis*, new species (page 63).

5. The only fragment discovered,  $\times 20$ .

Vicksburgian, Salt Mountain, 5 miles south of Jackson, Alabama.

Cat. No. 62601, U. S. N. M.

*Cystisella midwayanica*, new species (page 53).

6. View of the incrusting zoarium,  $\times 20$ .

Midwayan, Luverne, Crenshaw County, Alabama.

Cat. No. 62602, U. S. N. M.

*Schizaropsis convexa*, new species (page 57).

7. Both ovicelled and nonovicelled zoecia of the incrusting zoarium,  $\times 20$ , exhibiting the large spiramen.

Lower Jacksonian, Jackson, Mississippi.

Cat. No. 62603, U. S. N. M.

*Hippopodina vibraculifera*, new species (page 61).

8. Surface of the bilamellar zoarium,  $\times 20$ , with two ovicelled zoecia.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62604, U. S. N. M.

*Tubucella monilifera*, new species (page 63).

9. View of the bilamellar zoarium,  $\times 20$ , with one zoecium closed.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62605, U. S. N. M.

## PLATE 6.

*Tremotoichos rectifurcatum*, new species (page 59).

FIG. 1. Frontal side of a well-preserved fragment,  $\times 20$ .

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62606, U. S. N. M.

*Phylactella infundibulum*, new species (page 67).

2. Several zoecia,  $\times 20$ , including an ovicelled one.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62607, U. S. N. M.

*Adeonella folliculata*, new species (page 66).

FIG. 3. Fragment of the bilamellar zoarium, natural size, and the surface,  $\times 20$ .  
Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62608, U. S. N. M.

*Schizorthisecos interstitia* Lea, 1833 (page 75).

4. A zoarium,  $\times 6$ .

5. Upper surface of a zoarium,  $\times 20$ .

Claibornian, Claiborne, Alabama.

Cat. No. 62609, U. S. N. M.

*Hemicyclopora parajuncta*, new species (page 69).

6. Portion of the incrusting zoarium,  $\times 20$ .

Middle Jacksonian, near Lenuds Ferry, South Carolina.

Cat. No. 62610, U. S. N. M.

*Schizobathysella saccifera*, new species (page 70).

7. The incrusting zoarium,  $\times 20$ , exhibiting both ovicelled and nonovicelled zoecia.

Middle Jacksonian, Wilmington, North Carolina.

Cat. No. 62611, U. S. N. M.

*Perigastrella ovoidea*, new species (page 68).

8. View of the incrusting zoarium with quite convex zoecia,  $\times 20$ .

Upper Jacksonian, Bainbridge, Georgia.

Cat. No. 62613, U. S. N. M.

*Kleidionella grandis*, new species (page 72).

9. Portion of a small zoarium, natural size.

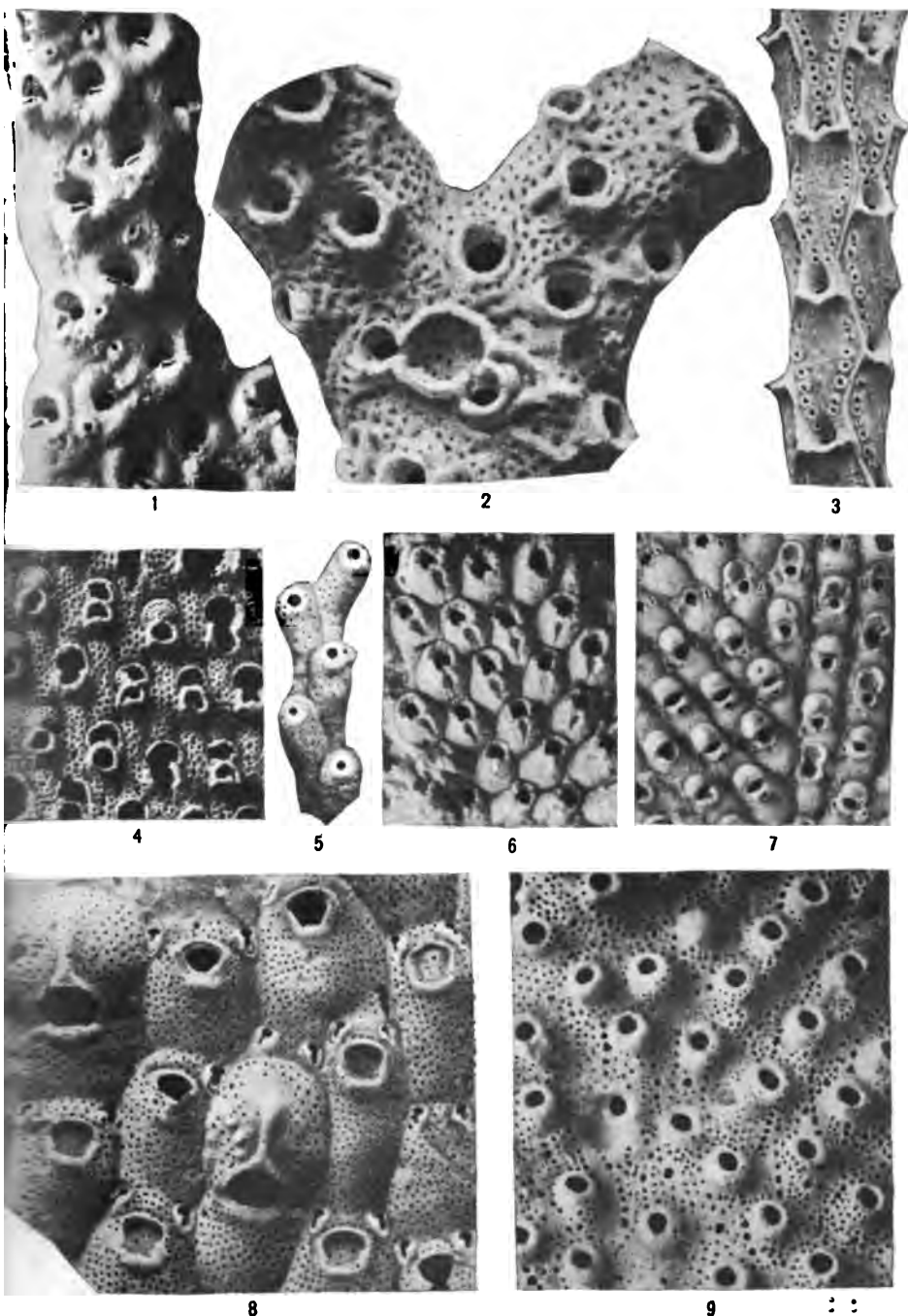
10. Surface of a zoarium,  $\times 20$ .

Upper Jacksonian, Cocoa Post Office, Choctow County, Alabama.

Cat. No. 62613, U. S. N. M.

52091°—17—6





AMERICAN TERTIARY CHEILOSTOME BRYOZOA.

FOR EXPLANATION OF PLATE SEE PAGE 80.





# INDEX.

[Synonyms are given in *italic*.]

	Page.		Page.
<i>Acanthionella</i> .....	72	<i>brendolensis</i> , <i>Rhamphostomella</i> .....	52
( <i>Escharifora</i> ) <i>typica</i> .....	72	<i>Brettia</i> .....	24
<i>Acanthocella</i> .....	34, 35	<i>bucculenta</i> , <i>Metrocrypta</i> .....	49
<i>erinacea</i> .....	36, 79	<i>Buffonella</i> .....	39
<i>Acropora</i> .....	37	<i>Bugulopsis</i> .....	23
<i>Acroporidae</i> .....	37	<i>Caberea</i> .....	23
<i>Adenifera</i> .....	10, 12	<i>Caberiella</i> .....	23
<i>inarmata</i> .....	12, 77	<i>Callopora</i> .....	10, 21
<i>Adeona</i> .....	65	<i>cancellata</i> , <i>Conescharellina</i> .....	76
( <i>Cellepora</i> ) <i>heckeli</i> .....	65	<i>Canda</i> .....	23
<i>Adeonella</i> .....	65	<i>capillaria</i> , <i>Vibracellina</i> .....	14
<i>folliculata</i> .....	66, 81	<i>capulus</i> , <i>Lunulites</i> .....	30
<i>polymorpha</i> .....	65	<i>Catanicella subseptentrionalis</i> .....	63, 80
( <i>Eschara</i> ) <i>polystomella</i> .....	65	<i>Catenicellidae</i> .....	63
<i>Adeonellopsis</i> .....	66	<i>Cellaria</i> .....	33
<i>foliacea</i> .....	66	<i>fistulosa</i> .....	33
<i>Adeonidae</i> .....	64	<i>Cellariidae</i> .....	32
<i>Aechmella</i> .....	27, 29	<i>Celleporidae</i> .....	71
<i>filimargo</i> .....	29, 78	<i>cellulosa</i> , <i>Retepora</i> .....	55
<i>Aetea</i> .....	22	<i>centralis</i> , <i>Macropora</i> .....	34
<i>anguina</i> .....	22	<i>cereoides</i> , <i>Tubucellaria</i> ( <i>Cellaria</i> ).....	62
<i>truncata</i> .....	22	<i>cervicornis</i> , <i>Porella</i> ( <i>Millepora</i> ).....	54
<i>Aeteidae</i> .....	9, 22	<i>Characodoma</i> .....	39
<i>Almuloia</i> .....	44	<i>Chellopora</i> .....	60
<i>Alderina</i> .....	10, 21	( <i>Lepralia</i> ) <i>sincera</i> .....	60
<i>Amphiblestrum</i> .....	10, 21	<i>Chelostomata</i> .....	9
<i>Amphiblestrum papillatum</i> .....	17	<i>Chorizopora</i> .....	38
<i>Anarthropora</i> .....	44	<i>claihornica</i> , <i>Schizemella</i> .....	47
<i>Anasca</i> .....	9	<i>Collostega</i> .....	25
<i>anguina</i> , <i>Aetea</i> .....	22	<i>Columnaria</i> .....	24
<i>Arachnopusia</i> .....	34	<i>columnaris</i> , <i>Phocoena</i> .....	54
<i>armata</i> , <i>Membranipora</i> .....	12	<i>Conescharellina</i> .....	76
<i>Arthropoma</i> .....	39	<i>cancellata</i> .....	76
<i>Ascophora</i> .....	34	<i>Conescharellinidae</i> .....	73
<i>aspera</i> , <i>Bathocella</i> ( <i>Mucronella</i> ).....	43	<i>conica</i> , <i>Trochopora</i> .....	13
<i>Aspidostomidae</i> .....	30	<i>Conopeum</i> .....	10
<i>auriculata</i> , <i>Schizomavella</i> ( <i>Lepralia</i> ).....	40	<i>contigua</i> , <i>Lunularia</i> .....	30
<i>australensis</i> , <i>Haswellia</i> ( <i>Myriozoum</i> ).....	58	<i>convexa</i> , <i>Schizaropsis</i> .....	57
<i>Bathocella</i> .....	43	<i>Corbulipora</i> .....	34
( <i>Mucronella</i> ) <i>aspera</i> .....	43	<i>coronopus</i> , <i>Schismopora</i> ( <i>Cellepora</i> ).....	71
<i>Batopora</i> .....	75	<i>Coscinopleura</i> .....	33
<i>rosula</i> .....	75	( <i>Eschara</i> ) <i>elegans</i> .....	33
<i>Beisselina</i> .....	37	<i>Coscinopleuridae</i> .....	32, 33
<i>benjamini</i> , <i>Membraniporina</i> .....	11	<i>costata</i> , <i>Rhamphostomella</i> .....	52
<i>biaperta</i> , <i>Stephanocella</i> ( <i>Lepralia</i> ).....	40	<i>Costazzia</i> .....	71
<i>bigibbera</i> , <i>Meniscopora</i> .....	64	( <i>Cellepora</i> ) <i>costazzi</i> .....	71
<i>biplanata</i> , <i>Metroporiella</i> .....	41	<i>costazzi</i> , <i>Costazzia</i> ( <i>Cellepora</i> ).....	71
<i>Bipora</i> .....	76	<i>Costulae</i> , <i>The</i> .....	34
<i>umbonata</i> .....	76	<i>crassa</i> , <i>Didymosella</i> .....	43
<i>bispinosa</i> , <i>Rhynchozoon</i> ( <i>Lepralia</i> ).....	56	<i>crassimarginata</i> , <i>Membranipora</i> .....	20
<i>bouei</i> , <i>Trochopora</i> ( <i>Lunulites</i> ).....	13	<i>Cribrendoecium</i> .....	34, 36
<i>Bracebridgia</i> .....	65	<i>tenuicostulatum</i> .....	36, 79
( <i>Porella</i> ) <i>emendata</i> .....	65	<i>Cribrilina</i> .....	34
<i>polymorpha</i> .....	65	<i>Cribrilina tubulifera</i> .....	35

	Page.		Page.
Cribrillinae.....	34	<i>Austroides, Membranipora</i> .....	15
ocullata, Watersipora (Lepralia).....	62	foliacea, Adeonellopsis.....	66
cupula, Mamillipora.....	76	foliiculata, Adeonella.....	66
Cylocopora.....	44	<i>fragilis, Vincularia</i> .....	24
Cystisella.....	53	fusiforme, Diplophloeos.....	26
midwayanica.....	53, 80	Galeopsidae.....	56
(Porella) saccata.....	53	Galeopsis.....	57
Dacryonella.....	27, 28	rabidus.....	57
octonaria.....	28, 78	Gargantua.....	27
Dacryopora.....	38	Gastropella.....	37
Dakaria.....	39	ventricosa.....	37, 38, 79
defixa, Enoplostomella.....	46	Gemellaria.....	24
descostilsi, Holoporella (Cellopora).....	72	loricata.....	25
Didymosella.....	43	Gemellipora.....	39
crassa.....	43, 79	Gephyrophora.....	58
(Porina) larvalis.....	43	polymorpha.....	58
digitata, Eschara.....	33	Gephyrotes.....	34
Diplophloeos.....	25, 26	Gigantopora.....	58
fusiforme.....	26, 78	lynchoides.....	58
Diploaxis.....	76	glomerata, Osthimosia (Reptocelleporina).....	71
placentula.....	76	gracile, Tessaradoma (Pustulopora).....	59
dissimilis, Metradolium.....	47	gracilis, Serupocellaria.....	23
distans, Lunularia.....	30	Grammella.....	10, 20
Distansescharella.....	34	transversa.....	20, 78
dutertrei, Mastigophora (Flustra).....	69	grandis, Kleidionella.....	72
eatonensis, Osthimosia (Cellopora).....	71	hagenowi, Hippozeugosella (Bactridium).....	42
edwardsi, Fedora.....	74	Haplopoma.....	38
Electra.....	9	Haswellia.....	58
Electrinidae.....	9	(Myrkozoum) australiensis.....	58
elegans, Coscinopleura (Eschara).....	33	heckeli, Adeona (Cellepora).....	65
Flabellipora.....	76	Hemicyclopora.....	69
Quadriceclaria.....	34	parajuncta.....	69, 81
elliptica, Serupocellaria.....	23	(Lepralia) polita.....	69
Ellisina.....	10, 19	Herpetopora.....	9
laxa.....	19, 78	Heterocella.....	24
Emballothea.....	39	Heterocleum.....	9
emendata, Bracebridgia (Porella).....	65	hexagonum, Rhagastoma.....	31
Enoplostomella.....	46	<i>hians, Membranipora</i> .....	12
defixa.....	46, 79	Hincakina.....	10, 15
erinaeae, Acanthocella.....	36	jacksonica.....	15, 77
Eschara digitata.....	33	megavicularia.....	16, 77
Escharellaidae.....	38	Hippadenella.....	54
Escharipora.....	33	(Flustra) margaritifera.....	54
Eucrates.....	24	Hippellozoon.....	55
Eucratidae.....	9, 24	(Retepora) novaezelandiae.....	55
eurita, Euritina (Eschara).....	31	Hippodiplosella.....	41
Euritina.....	31	Hippomenella.....	41
(Eschara) eurita.....	31	(Lepralia) mucronelliformis.....	42
evexa, Osthimosia.....	71	Hippopodina.....	60
eximipora, Ogivalina.....	16, 17	(Lepralia) feegenais.....	61
Exochella.....	43	vibraculifera.....	61, 80
Farciminaria.....	24	Hippopodiniidae.....	60
Farciminariidae.....	9, 23	Hippopora.....	39, 41
Fedora.....	74	Hippoporina.....	41
edwardsi.....	74	Hippothoe.....	38
feegenais, Hippopodina (Lepralia).....	61	Hippothoidae.....	38
fenestrata, Lunularia.....	30	Hippozeugosella.....	41, 42
filimargo, Aechmella.....	29	(Bactridium) hagenowi.....	42
fissa, Schizotheca (Lepralia).....	56	teges.....	42, 79
fistulosa, Cellaria.....	33	Holoporella.....	72
Flabellipora.....	76	(Cellepora) descostilsi.....	72
elegans.....	76	Hopliteilla.....	23
Floridina.....	25	Houzeauina.....	44
Floridinella.....	27, 28	Huxleya.....	24
vicksburgica.....	28, 78	hyndmanni, Mastigophora.....	69

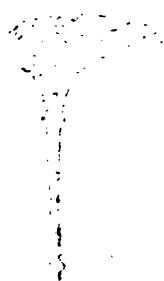
	Page.		Page.
imperati, Schizellozoon (Retepora).....	55	Membraniporina.....	10, 11
inarmata, Adenifera.....	12	benjamini.....	11, 77
infundibulum, Phylactella.....	67	Membrandocidium.....	10, 17
interstitia, Lunulites.....	75	pyriforme.....	17, 77
Lunulites (Cuspularia).....	75	Menipea.....	23
interstitia, Orbitolites.....	75	Meniscopora.....	64
interstitia, Schizothosecos (Orbitolites).....	74, 75	bigibbera.....	64
Jacksonia, Hinokisina.....	15	(Lepralia) subplana.....	64
Ochetosella.....	49	Metracolpota.....	34
Kleidiomella.....	72	robusta.....	35, 78
grandis.....	72, 81	Metradolium.....	47
Kymella.....	44	dissimilis.....	47, 79
(Cyclicopora) polaris.....	44	Metrarabdotos.....	60, 61
labrosa, Phylactella.....	67	(Eschara) moniliferum.....	61
Lacerna.....	39	Metrocrypta.....	49
lacroixii, Conopeum.....	11	buoculenta.....	49, 80
lacroixii, Membranipora.....	11	Metropieriella.....	39, 40
Lagenipora.....	70	bipianata.....	41, 79
socialis.....	70	(Schizoporella) lepralioides.....	40
Larnaeus.....	10	Micropora.....	27
larvatis, Didymosella (Porina).....	43	Microporellae.....	39, 44
laxa, Ellisina.....	19	Microporidae.....	25, 27
lazata, Membranipora.....	19	midwayana, Cystisella.....	53
Leiosella.....	48	monilifera, Tubucella.....	63
rostrifera.....	48, 80	moniliferum, Metrarabdotos (Eschara).....	61
lepralioides, Metropieriella (Schizoporella).....	40	Triphyllozoon (Retepora).....	56
levinseni, Velumella (Onychocella).....	26	Mucronella.....	52
loricata, Gemellaria.....	25	(Lepralia) peachi.....	52
Lunularia.....	30	mucronelliformis, Hippomenella (Lepralia).....	42
contigua.....	30	Nellia.....	24
distans.....	30	Nimba.....	39
fenestrata.....	30	novezelandiae, Hippellozoon (Retepora).....	55
reversa.....	30	Ochetosella.....	49
vicksburgensis.....	30	jacksonica.....	49, 80
Lunulariidae.....	25, 30	oetonaria, Dacryonella.....	28
Lunulites capulus.....	30	Odontionella.....	10, 12
interstitia.....	75	(Membranipora) savartii.....	12
(Cuspularia) interstitia.....	75	Ogivalina.....	10, 16
lynchoides, Gigantopora.....	58	eximipora.....	16, 17, 77
Macropora.....	33	Onychocella.....	25
centralis.....	34	Onychocella solida.....	26
magnilabris, Steganoporella (Membranipora).....	32	Onychocellidae.....	25
magnirostris, Tubiporella (Lepralia).....	63	Opesiulidae.....	25
Malacostega.....	9	Orbitolites interstitia.....	75
mamillaris, Tubucella (Eschara).....	62	Orbitulipora.....	75
Mamillipora.....	76	(Cellepora) petiolus.....	75
cupula.....	76	Osthimosia.....	71
margaritifera, Hippadenella (Flustra).....	54	(Cellepora) eatonensis.....	71
Mastigophora.....	69	evexa.....	71
(Flustra) dinterrei.....	69	(Reptocelleporina) glomerata.....	71
hyndmanni.....	69	Otionella.....	10, 13
mediaviculifera, Stamenocella.....	22	perforata.....	13, 77
megavicularia, Hinokisina.....	16	oviodes, Perigastrella.....	68
Membranocellaridae.....	32	Pachytheca.....	37
Membranipora.....	9	papillatum, Amphiblestrum.....	17
armata.....	12	parajuncta, Hamicyclopora.....	69
crassimarginata.....	20	peachi, Mucronella (Lepralia).....	52
fustroides.....	15	perforata, Otionella.....	13
hians.....	12	Perigastrella.....	68
lacroixii.....	11	(Lepralia) labiata.....	68
lazata.....	19	oviodes.....	68, 81
Membraniporae.....	9	Periporocella.....	10, 18
Membraniporella.....	34	tantilla.....	18, 19, 77
Membraniporida.....	10, 21	Peristomella.....	43
porrecta.....	21, 78	Peristomellae.....	39, 43

	Page.		Page.
petiolus, Orbitulipora (Cellepora).....	75	Schizemiella.....	47
Phoceana.....	54	californica.....	47, 79
columnaris.....	54	Schizobathysella.....	69
Phonicoea.....	39	sacifera.....	70, 81
Phylactella.....	67	Schizomavella.....	39, 40
infundibulum.....	67, 80	(Lepralia) auriculata.....	40
labrosa.....	67	Schizopodrella.....	39, 40
Phylactellidae.....	66	(Lepralia) unicornis.....	40
placantula, Diplotaxis.....	76	Schizoporellae.....	39
Plagiosmittia.....	51	Schizorthoseos.....	74
regularis.....	51, 80	(Orbitolites) interstitia.....	74, 81
polaris, Kymella (Cyclopora).....	44	Schizotheca.....	56
polita, Hemicyclopora (Lepralia).....	69	(Lepralia) fissa.....	56
polymorpha, Adeonella.....	65	Scruparia.....	24
Bracebridgia.....	65	Scrupocellaria.....	23
Gephyrophora.....	58	elliptica.....	23
polystomella, Adeonella (Eschara).....	65	gracilis.....	23
Porella.....	53	Scrupocellariidae.....	9, 23
(Millepora) cervicornis.....	54	Semiliaswellia.....	58
Porina proboscidea.....	58	simplex, Stichoporina.....	74
porrecta, Membraniporida.....	21	sincera, Chelipora (Lepralia).....	60
prima, Gemellaria.....	25	Smitia.....	51
proboscidea, Porina.....	58	Smittina.....	51
Pseudostega.....	32	(Lepralia) reticulata.....	51
Puellina.....	34	Smittinidae.....	50
pumicosa, Schismopora (Cellepora).....	71	Smittipora.....	25
pyriforme, Membrendocium.....	17	socialis, Lagenipora.....	70
Pyrpura.....	9	solida, Onychocella.....	26
Quadriceclaria.....	33, 34	Stamenocella.....	10, 21
elegans.....	34	mediavulifera.....	22, 78
rabidus, Galeopsis.....	57	Steganoporella.....	31
Ramphonotus.....	10, 21	(Membranipora) magniflabris.....	32
rectifurcatum, Tremotolchos.....	59	Steganoporellidae.....	25, 31
Rectonchocella.....	25	Stephanocella.....	39, 40
regularis, Plagiosmittia.....	51	(Lepralia) bisperata.....	40
Retepora.....	55	Stichoporina.....	74
cellulosa.....	55	simplex.....	74
Reteporidae.....	55	Stomachetosella.....	45
reticulata, Smittina (Lepralia).....	51	crassicollis.....	45, 79
reversa, Lunularia.....	30	Stomachetosellidae.....	44
Rhabdozoum.....	23	subplana, Meniscopora (Lepralia).....	64
Rhagastostoma.....	31	subseptentrionalis, Catenicella.....	63
hexagonum.....	31	tantilla, Periporosella.....	18, 19
Rhamphostomella.....	52	Tegella.....	10, 21
brandolensis.....	52	teges, Hippozeugosella.....	42
costata.....	52	tenulcostulatum, Cribrendocium.....	36
Rhynchopora.....	56	Tessaradoma.....	59
Rhynchozoon.....	56	(Pustulopora) gracile.....	59
(Lepralia) bispinosa.....	56	Tetraplaria.....	39
robusta, Metracolpaea.....	35	Thalamoporella.....	32
Romancheina.....	43	(Fiustra) rozleri.....	32
Roselliana.....	27	Thalamoporellidae.....	25, 32
rostrifera, Leiosella.....	48	transversa, Grammella.....	20
rosula, Batopora.....	75	Tremopora.....	10
rozleri, Thalamoporella (Fiustra).....	32	Tremotolchos.....	59
saccata, Cysticella (Porella).....	53	rectifurcatum.....	59, 80
sacifera, Schizobathysella.....	70	Triphyllazoon.....	56
savartii, Odontionella (Membranipora).....	12	(Retepora) moniliferum.....	56
Schismopora.....	71	Trochopora.....	10, 13
(Cellepora) coronopus.....	71	(Lunulites) bouel.....	13
(Cellepora) pumicosa.....	71	conica.....	13
Schizaropsis.....	57	truncata, Aetea.....	22
convexa.....	57, 80	Trypostega.....	38
Schizellozoon.....	55	Tubiporella.....	63
(Retepora) imperati.....	55	(Lepralia) magnirostris.....	63

	Page.		Page.
Tubucella.....	62	Velumella.....	25, 26
(Eschara) mamillaris.....	62	(Onychocella) levinsoni.....	26
monilifera.....	63, 80	ventricosa, Gastropella.....	37, 38
Tubucellaria.....	62	verrucosa, Umbonula (Callepora).....	54
(Cellaria) cereoides.....	62	Vibracellina.....	10, 14
Tubucellariidae.....	62	capillaria.....	14, 77
tubulifera, Cribrellina.....	35	vibraculifera, Hippopodina.....	61
typica, Acanthionella (Escharifera).....	72	vicksburgenses, Lunularia.....	30
umbonata, Bipora.....	76	vicksburgica, Floridinella.....	28
Umbonula.....	54	Vincularia fragilis.....	24
(Callepora) verrucosa.....	54	Watersipora.....	60, 62
unicornis, Schizopodrella (Lepralia).....	40	(Lepralia) cucullata.....	62













UNIV. OF MICH.

AUG 14 1924

BOUND

UNIVERSITY OF MICHIGAN

3 9016 63644 8612

